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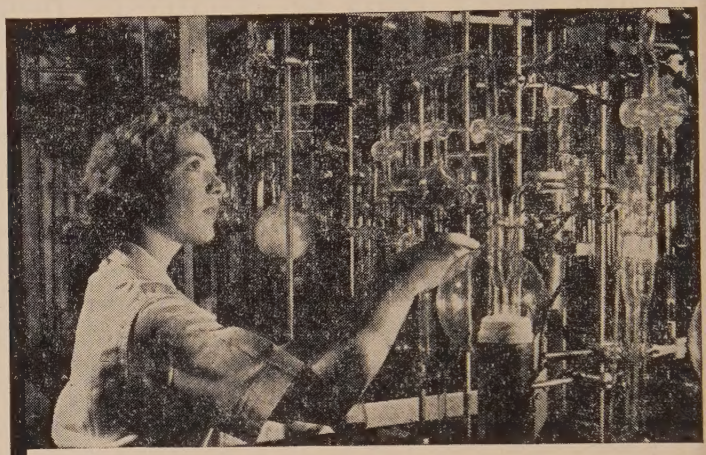

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Earle (N. W.), Pankaskie (J. E.) & Sun (Yun-pei). **Microbioassay of insecticide residues in plant tissues without extraction, with special reference to aldrin and dieldrin.**—*J. Ass. off. agric. Chem.* **42** no. 3 pp. 586–592, 17 refs. Washington, D.C., 1959.

The following is virtually the authors' summary. The method of bioassay used for estimating insecticide residues on plant material, in which adults of *Drosophila melanogaster* Mg. are allowed to feed directly on macerated plant tissues [*R.A.E.*, A **42** 396], is described. The amounts of insecticide residues are found by comparing the mortalities resulting from exposure to the treated samples with those of standards containing known amounts of the same insecticide. The method permits the detection of aldrin and dieldrin at a level of 0·1 part per million in a number of fruits and vegetables. The substitution of 6-dram vials for 4-oz. jars can increase the sensitivity 2–5 times.

The relatively low water-solubility of many insecticides does not prevent their detection by this method. It appears that the flies are mainly poisoned by contact and by ingestion of the toxicant.

The validity of this method, at least for aldrin and dieldrin, was demonstrated in two ways. Analyses of duplicate portions of treated samples by this method and by a " dry-film " or a chemical method produced results that agreed quite closely. Different methods of preparing potato standards, simulating different types of residues from field treatment, gave comparable mortalities, indicating that the standards give mortalities equivalent to the same amount of residue from a field treatment.

In general, any material on which *Drosophila* can subsist for 24 hours can be bioassayed by this procedure. Materials in which the flies cannot live for one day may be mixed with adequate food and then bioassayed. It is assumed, of course, that the insecticide is toxic enough to the flies to give the desired sensitivity. One disadvantage of the method is that the sensitivity cannot be increased to the same extent as is possible with methods involving extraction.

Domenichini (G.). **Descrizione di un nuovo** *Tetrastichus* **malese (Hym. Eulophidae) parassita di** *Xyleborus* **spp. (Col. Scolytidae).** [Description of a new Malayan *Tetrastichus*, a parasite of *Xyleborus* spp.]—*Ent. Ber.* **20** no. 12 pp. 256–258, 1 ref. Amsterdam, 1960.

Kalshoven (L. G. E.). **Observations on the parasites of** *Xyleborus* **twig-borers in Java.**— *T. c.* pp. 259–262, 16 refs.

In the second of these papers, the author reviews earlier records of two Hymenopterous parasites of the twig-borers, *Xyleborus morigerus* Bldf. and *X. morstatti* Hag., which infest coffee and other plants in Java [*cf. R.A.E.*, A **3** 312; **16** 115; **20** 567; **48** 194]. One of them, described in the first paper from adults of both sexes as *Tetrastichus xyleborорum*, sp. n., was first found attacking *X. morigerus*. The author observed adults visiting infested mahogany (*Swietenia mahagoni*) and describes the way in which the females explore the branches and oviposit in the brood chambers. The Eulophid was found in brood chambers in teak (*Tectona*) and occasionally *Leucaena*, but not in borer-infested roots or stem bases of tea seedlings. During the spread of *X. morstatti* in Java, *T. xyleborорum* parasitised both *X. morstatti* and *X. morigerus*, but its numbers decreased with the decline of the latter; later, where *X. morigerus* had been almost completely replaced by the other borer, the parasite reappeared on *X. morstatti* and would no longer attack *X. morigerus* [*cf.* **20** 567].

Smyth (E. G.). **A new Tephritid fly injurious to tomatoes in Peru.**—*Bull. Calif. Dep. Agric.* **49** no. 1 pp. 16–22, 3 figs. Sacramento, Cal., 1960.

Rhagoletis lycopersella, sp. n., is described from adults taken in the Chicama Valley, near Trujillo, Peru. This Trypetid appears to be indigenous in the cultivated valleys of the dry coastal plain of western Peru, where it infests a common wild tomato, and it has become a severe pest of cultivated tomatos there. Fruits of the wild tomato are small and numerous, and not more than 50–60 per cent. of them are attacked, one larva developing in each. On cultivated tomato, however, few of the fruits escape attack, and up to a dozen or more larvae develop in each. The fruits are infested while quite small; they then cease to grow, and become distorted. Putrefaction sets in as soon as the exit holes of the larvae give access to air, and this is followed by attack by secondary insect pests and bacteria. Infestation was first reported in 1929, and subsequent life-history studies showed that the combined egg and larval stages lasted an average of 19–23 days in September, 18–22 days in December, and one day less in February. The duration of the pupal stage also varied with season. There were usually two and sometimes three distinct periods of emergence from the same batch of puparia. The first occurred 26–38 days after pupation, when about 58 per cent. of the adults emerged, and the minimum duration of the pupal stage for these was 27½ days for individuals pupating in February and 36 days for those doing so in September. The remaining pupae aestivated before giving rise to adults. Aestivation periods of 3–8 months were observed, but the limit was not ascertained. The addition of moisture to dishes containing pupae was not essential to their survival, though it induced emergence, and this is perhaps related to conditions in the area, where rain falls once in 15–17 years and crops have to be irrigated. The protracted aestivation period would favour accidental introduction of the pest into other countries with packing material, and in this connection it is noted that the climate of southern California resembles that of the Chicama Valley.

Dadd (R. H.). **Observations on the palatability and utilisation of food by locusts, with particular reference to the interpretation of performances in growth trials using synthetic diets.**—*Ent. exp. appl.* **3** no. 4 pp. 283–304, 1 graph, 32 refs. Amsterdam, 1960. (With a summary in French.)

The following is virtually the author's summary. The phagostimulant effectiveness of substances used in artificial diets for *Schistocerca gregaria* (Forsk.) was assessed by comparing the amounts of faecal material produced by hungry hoppers allowed to feed on filter paper soaked in solutions of the substances with the amounts produced when water alone was used on the paper. Sucrose, glucose and wheat-germ oil caused markedly greater faecal production than distilled water alone. Chlorophyll, carotene, casein, peptone, olive oil, a nutritional salt mixture, a mixture of B vitamins, choline chloride and ascorbic acid were no more effective than water. Aqueous extracts of yeast were generally as effective as sugar but sometimes seemed inhibitory at high concentrations. As growth could continue on diets lacking yeast, sugar and wheat-germ oil, the only dietary components found to have pronounced phagostimulatory properties, it appears that special gustatory stimuli are unnecessary for initiating feeding activity in hungry hoppers. This view was later borne out in experiments in which the amounts of various complete diets eaten and the faeces produced from them were compared.

No major differences in feeding attributable to palatability were apparent, but the amounts of food taken were found to be related to differences in utilisability. With both *S. gregaria* and *Locusta migratoria* (L.), the lower the utilisability of the food the greater the amount eaten, and, for a range of diets of various utilisabilities, including fresh grass, the values obtained by multiplying the amount eaten (dry weight) by the coefficient of utilisation were similar for each species. It is suggested that in locust hoppers special gustatory stimuli are unnecessary for the initiation of feeding and of minor importance in sustaining it. The amount of food taken appears to be largely regulated by its over-all utilisability where food of more or less adequate nutritional composition is concerned, a situation not wholly unexpected in insects able to thrive on diverse food-plants.

Gupta (P. D.) & Thorsteinson (A. J.). **Food plant relationships of the diamond-back moth (*Plutella maculipennis* (Curt.)). II. Sensory regulation of oviposition of the adult female.**—*Ent. exp. appl.* **3** no. 4 pp. 305–314, 3 refs. Amsterdam, 1960. (With a summary in French.)

The following is virtually the authors' summary of this account of further investigations on the food-plant relations of *Plutella maculipennis* (Curt.) [*cf. R.A.E.*, A **49** 516]. Oviposition responses to natural and artificial substrates were investigated. More eggs were deposited on plants that contain isothiocyanates (natural food-plants) than on others. Depletion of isothiocyanate content by sulphur-deficient plant nutrition appeared to reduce attractiveness of food-plants as egg substrates. Eggs were laid preferentially in concavities of leaves or stems. Significantly more eggs were laid on dimpled than smooth polyvinyl plastic surfaces. On both types of plastic substrate, more eggs were laid if allyl isothiocyanate or juice of the leaves of mustard (*Brassica juncea*) was added. Mustard-leaf juice contains allyl isothiocyanate, but is more stimulating to oviposition, indicating that other factors contribute to the total effect.

Although the coumarin in *Melilotus* spp. tended to inhibit oviposition, *P. maculipennis* may be induced to increase egg-deposition on such plants by treating them with allyl isothiocyanate. Unknown inhibitory constituents in tomato leaves prevented egg-laying, even in the presence of allyl isothiocyanate. It was concluded that oviposition is regulated significantly by external stimuli and that inhibitory chemical influences as well as positive chemical stimuli and texture of the surface are all significant factors.

Auclair (J. L.) & Cartier (J. J.). **Effets comparés de jeûnes intermittents et de périodes équivalentes de subsistance sur des variétés résistantes ou sensibles de pois, *Pisum sativum* L., sur la croissance, la reproduction et l'excrétion du puceron du pois, *Acyrthosiphon pisum* (Harr.) (homoptères: aphidides).**—*Ent. exp. appl.* **3** no. 4 pp. 315–326, 2 graphs, 11 refs. Amsterdam, 1960. (With a summary in English.)

The following is virtually the authors' summary of this account of greenhouse experiments carried out in Canada. The growth of *Macrosiphum* (*Acyrthosiphon*) *pisum* (Harris) reared continuously on two resistant varieties of peas was compared with that of aphids starved for 10–12 hr. daily. Growth of aphids reared on these varieties for 8–14 hr. daily was comparable with that of aphids starved for 4–8 hr. daily. Aphids not reared continuously on the resistant varieties spent the remaining period of each day on a

susceptible variety. Similar results were obtained when reproduction was measured. Aphid growth and reproduction on resistant plants were therefore similar to those of aphids subjected to semi-starvation. These results do not support the hypothesis that substances toxic to the aphid are present in resistant plants.

Following each period of fasting, the frequency and rate of excretion (and ingestion) of aphids placed on a susceptible plant were more than doubled, as compared with the controls. However, no such increases in excretion were observed when fasting aphids were placed on a resistant plant. These results suggest that sap-ingestion can be increased when the starved aphid resumes feeding on a susceptible plant, but not when it does so on a resistant one. The hypothesis of Banks & Nixon [*R.A.E.*, A **48** 540] on the mechanism of sap-ingestion by an aphid is discussed and considered applicable to *M. pisum* feeding on a susceptible plant.

Johnson (B.) & Birks (P. R.). **Studies on wing polymorphism in aphids. I. The developmental process involved in the production of the different forms.**—*Ent. exp. appl.* **3** no. 4 pp. 327–339, 2 figs., 31 refs. Amsterdam, 1960. (With a summary in German.)

The following is virtually the authors' summary of this paper, which is based on laboratory investigations carried out with *Aphis craccivora* Koch. A theory of the nature of the developmental process resulting in wing polymorphism in aphids is proposed. It is suggested that all aphids begin development as presumptive alatae, and that apterae and intermediates are forms that have become irreversibly diverted from the alate course during development. Experiments are described indicating that diversion resulting in the production of apterae can occur at any time over a protracted period extending from the late embryonic stages until the second nymphal moult. Prenatal diversion was illustrated in the progeny of apterous aphids that had been kept on seedlings at 30°C. [86°F.] for a few days, and in the progeny of young alate aphids. Decapitation of adult aphids induced deposition of nymphs and also resulted in prenatal diversion of the progeny. Post-natal diversion was readily brought about in first- and second-instar nymphs by keeping them on seedling food-plants. In the third and fourth instars, it could only be produced by extreme measures, such as severe injury, and by parasitism. It is suggested that the theory of polymorphism developed may be applied to other groups of insects with adults of different forms.

Veber (J.) & Jasič (J.). **Microsporidia as a factor in reducing the fecundity in insects.**—*J. Insect Path.* **3** no. 2 pp. 103–111, 3 graphs, 3 refs. New York, N.Y., 1961.

The following is based on the authors' summary. Greatly reduced fecundity was observed in laboratory tests with females of two species of Lepidoptera fed as larvae on sublethal amounts of a spore suspension of *Nosema bombycis*. Normal females of *Bombyx mori* (L.) laid an average of 543 eggs each. Those that ingested 5×10^3 and 5×10^4 spores each as fifth-instar larvae laid averages of only 341 and 322. Those that ingested 5×10^3 spores at the beginning of the fourth instar laid only 209. Normal females of *Hyphantria cunea* (Dru.) laid an average of 607 eggs each, and those that ingested 75×10^4 spores as sixth-instar larvae laid only 443.

Lower (H. F.). **The pathology of starvation in an armyworm,** *Persectania ewingii* **(Westwood) (Lepidoptera: Noctuidae).**—*J. Insect Path.* **3** no. 2 pp. 129–142, 6 figs., 3 refs. New York, N.Y., 1961.

The following is virtually the author's summary. Larvae of *Persectania ewingii* (Westw.) are ill-adapted to withstand starvation. Without food, young larvae soon die; older larvae may either die, or pupate and produce defective moths after a greatly prolonged period of development. Certain structural and chemical changes are common to all larvae undergoing starvation. The mid-gut epithelium degenerates; the hypodermis shrinks and retracts irregularly from both the cuticle and the basement membrane, while uric acid crystals accumulate in it; secondary pigments are deposited in the cuticle and in the other internal tissues; the proportion of stored fat rapidly diminishes; the nitrogen content significantly rises. A relatively constant proportion of water is maintained, which differs little from that of the feeding larvae. Even a short period of starvation may bring about a permanent derangement of the metabolism, so that if larvae subsequently resume feeding they are either capable of limited and abnormal growth only, or, if they complete their development, the resultant moths are sexually defective.

Cantwell (G. E.), Dutky (S. R.), Keller (J. C.) & Thompson (C. G.). **Results of tests with** *Bacillus thuringiensis* **Berliner against gypsy moth larvae.**—*J. Insect Path.* **3** no. 2 pp. 143–147, 1 ref. New York, N.Y., 1961.

The following is substantially the authors' summary. Small-scale aerial spray applications of *Bacillus thuringiensis* against first-, second- and third-instar larvae of *Lymantria* (*Porthetria*) *dispar* (L.) in woodlands in Connecticut and Vermont in 1959–60 gave encouraging results. The field results compared favourably with those of chemical treatments applied concurrently, but the relative effectiveness of *B. thuringiensis* and the standard DDT spray treatment was not fully established. Laboratory and field results indicate that the application of 50×10^{12} spores per acre will prevent excessive tree defoliation by the larvae.

Jaques (R. P.). **Control of some Lepidopterous pests of apple with commercial preparations of** *Bacillus thuringiensis* **Berliner.**—*J. Insect Path.* **3** no. 2 pp. 167–182, 1 fig., 8 refs. New York, N.Y., 1961.

The following is virtually the author's summary of this account of tests carried out in Nova Scotia in 1959–60. The effectiveness of commercially produced wettable-powder preparations containing $30–150 \times 10^9$ spores of *Bacillus thuringiensis* per g. was evaluated for the control of seven Lepidopterous pests of apple. Laboratory and orchard tests showed that concentrations of 1–2 lb. wettable powder per 100 gal. spray satisfactorily controlled larvae of *Operophtera brumata* (L.), *Alsophila pometaria* (Harris), and *Malacosoma americanum* (F.). In laboratory tests, similar concentrations of spores killed larvae of *Spilonota ocellana* (Schiff.), but orchard applications had less effect. Up to 6 lb. spore preparation per 100 gal. spray were required to cause 50 per cent. reductions in the number of *Argyrotaenia mariana* (Fern.). The bacteria were tested less extensively under cage or laboratory conditions against larvae of *Datana ministra* (Dru.) and *Cydia pomonella* (L.), and appeared to kill them.

Raun (E. S.). **A granulosis of the armyworm, *Pseudaletia unipuncta* (Haworth), in Iowa.**—*J. Insect Path.* **3** no. 2 pp. 224–225. New York, N.Y., 1961.

Larvae of *Pseudaletia unipuncta* (Haw.) collected from brome grass [*Bromus*] and lucerne in southern and central Iowa in June 1960 were found to be infected with a granulosis virus, the symptoms and pathology of which resembled those of a disease of this armyworm already recorded [*R.A.E.*, A **48** 509]. Details of the resulting mortality are given. The two localities concerned were 140 miles apart.

Klostermeyer (E. C.) & Skotland (C. B.). **Pesticide chemicals as a factor in hop die-out.**—*Stas Circ. Wash. agric. Exp. Stas* no. 362, [1 +] 11 pp., 11 figs., 4 refs. [Pullman, Wash.] 1959.

In 1958, cases of severe die-back were reported in hops in the Yakima Valley of Washington, and this was found to be associated with the previous use of heptachlor to protect other crops. The symptoms, which resembled those caused by fungi, appeared in July–August, and included cracking of the bark or epidermis of the bines and swelling of the crowns, with discoloration and rotting of the xylem of the crowns and roots. In experiments in which hop seedlings and cuttings were grown in soil treated with heptachlor at rates of 1–8 lb. per acre, damage similar to that seen in the field was produced. When cuttings were grown in contact with both treated and untreated soil separated by a barrier, only the parts in contact with treated soil were affected, showing that heptachlor is injurious only when in contact with the plant and is not translocated within it. The damage might be caused by heptachlor itself, related compounds present in the technical material, or other substances present in the formulated insecticide, or by effects on disease organisms; in experiments, both technical heptachlor and formulations of it caused damage, but the 98·6 per cent. pure material did not. Heptachlor persists for long periods in soil, either unchanged or as the epoxide, but replanting of hops after three years has been successful.

Bacon (O. G.), Swift (J. E.) & Burton (V. E.). **Resistance of *Lygus* bugs in seed alfalfa to toxicity of toxaphene.**—*Calif. Agric.* **14** no. 2 pp. 5–6. Berkeley, Cal., 1960.

In parts of California, the control of *Lygus* spp. by toxaphene on lucerne seed crops is less effective than formerly, especially late in the season [*cf.* *R.A.E.*, A **44** 374]. In tests made in 1959, the effects of toxaphene and other chemicals applied from aircraft were compared, Mirid populations being estimated by sweeping. In June, a toxaphene emulsion spray affording 3 lb. toxaphene in 10 U.S. gal. per acre was compared with a dust of 10 per cent. toxaphene and 50 per cent. sulphur applied at 30 lb. per acre. Both treatments kept numbers low for 15 days, after which the dust lost its effectiveness more rapidly than the spray. In July, sprays affording 3 lb. toxaphene or 0·5 lb. mevinphos (Phosdrin) from emulsion concentrates and 1 lb. trichlorphon (Dylox) from a soluble powder were applied twice in 10 U.S. gal. per acre at an interval of ten days. Mevinphos and trichlorphon gave high initial kills, but the residual effects were less than those of toxaphene.

In a further test, in which sprays were again applied at 10 U.S. gal. per acre, the effects of toxaphene at 4 lb., endrin at 0·4 lb., malathion and Methyl Trithion [O,O-dimethyl S-p-chlorophenylthiomethyl phosphorodithioate] at 1 lb., and dimethoate and phosphamidon at 0·5 lb. per acre, mixtures of toxaphene at 3 lb. with trichlorphon at 1 lb., mevinphos at 0·5 lb. or Volck Supreme oil [**49** 541] at 2 U.S. quarts per acre, and a mixture of DDT and trichlorphon at 1 lb. each per acre were compared. Dimethoate was the most effective and persistent; malathion, Methyl Trithion and phosphamidon also gave high initial kills, but lost their effectiveness in 7–11 days. The toxaphene-trichlorphon, toxaphene-mevinphos and DDT-trichlorphon mixtures showed high initial kills, followed by an increase in numbers of nymphs within 11 days; endrin was effective for about 11 days. The addition of the oil appeared to increase the initial kill from toxaphene, but not its residual effectiveness. Further tests of toxaphene with oil showed little advantage over toxaphene alone, and there were indications of damage to the crop.

It is concluded that toxaphene is still the preferred treatment for seed crops of lucerne, but that the amount applied should be increased from 3 to 4 lb. per acre.

Madsen (H. F.) & Westigard (P. H.). **Resistance to acaricides by European red mite studied in Bartlett pear field plots.**—*Calif. Agric.* **14** no. 2 pp. 7–8, 1 fig. Berkeley, Cal., 1960.

Resistance to chlorfenson (ovex), chlorobenzilate and Kelthane has been reported in *Panonychus ulmi* (Koch) in California [*R.A.E.*, A **48** 180]. Since this mite cannot be reared in the laboratory, field tests were made on pear trees, the leaves of which are very sensitive to attack at temperatures above 90°F. Sprays were applied to 1-acre plots at 900–1,000 U.S. gal. per acre. The materials tested in 1958 were 7·5 lb. ethion and 3·7 lb. Tedion, both alone and with 11·2 U.S. gal. Volck Supreme oil [**49** 541] or 7·5 U.S. quarts glyodin, per acre. Ethion alone was applied four times, in May–August, and the rest three times, twice before and once after harvest. In 1959, the acaricides were applied at 9·4 lb., glyodin at 9·4 U.S. quarts and the oil at 9·4 U.S. gal. per acre, in the same combinations as before, first in May and thereafter when mite counts showed potentially damaging populations.

Ethion alone failed to prevent increases in mite populations and caused damage to the foliage, but ethion and Tedion with oil gave good control in both years, the latter being outstanding. Ethion and Tedion with glyodin, and Tedion alone, gave good control in 1958 but failed in 1959, Tedion with glyodin being particularly ineffective. It is thought that strains of *P. ulmi* resistant to these compounds developed in the course of the work, and that the results illustrate the danger of repeated use of the same compound.

Simanton (W. A.). **Seasonal populations of *Citrus* insects and mites in commercial groves.**—*Florida Ent.* **43** no. 2 pp. 49–57, 4 graphs, 3 refs. Gainesville, Fla., 1960.

Monthly observations of the abundance of 19 species or groups of insects and mites infesting *Citrus* were made in 1951–58 in Florida, on samples of five representative trees, in 130 typical commercial groves, about 13 per cent. of which received little or no treatment against pests. The results are presented on graphs showing average, maximum and minimum values for each month of the year. Each pest had a characteristic annual cycle of

abundance, and most reached a peak of population in early summer and a low level in September. These included *Lepidosaphes beckii* (Newm.), *L. gloverii* (Pack.), *Saissetia oleae* (Bern.), *Chrysomphalus ficus* Ashm. (*aonidum*, auct.), *Planococcus* (*Pseudococcus*) *citri* (Risso), *Ceroplastes floridensis* Comst., *Eotetranychus sexmaculatus* (Ril.) and *Panonychus citri* (McG.). Aphids were most abundant in spring and autumn, and declined in numbers during the summer, as also did *Parlatoria pergandii* Comst. and *Coccus hesperidum* L.; *Dialeurodes* spp. were most abundant in summer and fluctuated in numbers in autumn. *Phyllocoptruta oleivora* (Ashm.), *Pinnaspis aspidistrae* (Sign.) and *Eutetranychus banksi* (McG.) were abundant in late autumn as well as at other times. The last, which was first observed as a *Citrus* pest in Florida in 1953, has become more numerous with each successive year. *Aonidiella citrina* (Coq.) and *Icerya purchasi* Mask. reached their lowest population levels in August. *L. beckii* was reduced in numbers in the spring of 1959, probably as a result of parasitism by *Aphytis lepidosaphes* Comp., which appeared in Florida in 1958 [*cf. R.A.E.*, A **49** 40]. The winter of 1957–58 was severe, and populations of *Chrysomphalus ficus*, *L. beckii*, *S. oleae*, *Panonychus citri*, *Planococcus citri* and aphids were reduced for 2–4 months, while those of *Parlatoria pergandii* and *Eotetranychus sexmaculatus* reached new peaks in 1958 and those of *C. ficus* and *S. oleae* in 1959.

King (J. R.), Cohen (M.) & Johnson (R. B.). **Film-forming sprays on *Citrus* in Florida.**—*Florida Ent.* **43** no. 2 pp. 59–64. Gainesville, Fla., 1960.

The possibility of protecting plants from pests and diseases by coating them with a film of non-toxic material has been suggested, and the method was tested in Florida in 1955–58 for the protection of *Citrus* crops from *Phyllocoptruta oleivora* (Ashm.) and greasy-spot disease. Emulsions containing about 50 per cent. solid matter, in particles less than 1 μ in size, were diluted to 10 per cent. with water and applied to fruiting branches; the materials tested included polyethylene, acrylic resin, vinyl acetate, wax, polyvinyl alcohol and hydroxyethyl cellulose. The polyethylene formulations proved phytotoxic; most of the other materials became hard and brittle when dry, but four formulations, including an acrylic resin, formed flexible, glossy films lasting for several months. The acrylic resin, a polyethylene formulation and a wax were applied to mature orange trees in 2·5, 5 and 10 per cent. sprays, respectively, the polyethylene and wax films were not durable, and the former showed toxicity in June, though not in October, at the higher dosages. The acrylic resin gave a persistent, pliable film without ill-effects on the trees, and was selected for further tests in 1958.

When applied as a 5 per cent. spray to grapefruit trees, it did not reduce the percentage of leaves infested by *P. oleivora*, as did chlorobenzilate and Kepone [2,3,3a,4,5,6,7,7a,8,8-decachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene-1-one] at 1 lb. 25 per cent. wettable powder and zineb at 0·5 lb. 65 per cent. wettable powder per 100 U.S. gal. It did, however, reduce the density of the populations, the mites being confined to areas not covered by the film, and it protected the fruits from damage as effectively as zineb and better than sulphur at 5 or 10 lb. per 100 U.S. gal. On orange, the resin, applied at 2·5, 5 and 10 per cent., was inferior to zineb at 0·5 and 1 lb. and to sulphur at 10 lb. per 100 U.S. gal., but it reduced the severity of the injury to the fruits. It proved effective against greasy spot. Difficulty was encountered in obtaining complete coverage with sprays of this type, but the results are held to justify further work.

Genung (W. G.). **Comparison of insecticides, insect pathogens and insecticide-pathogen combinations for control of cabbage looper** *Trichoplusia ni* **(Hbn.).**—*Florida Ent.* **43** no. 2 pp. 65–68, 2 graphs, 12 refs. Gainesville, Fla., 1960. **Erratum.**—*T.c.* no. 3 p. 117.

Insecticides, pathogens and combinations of the two were compared in sprays against larvae of *Trichoplusia ni* (Hb.) on collards in Florida. The sprays were applied at 100 U.S. gal. per acre and afforded, per acre, 2 lb. toxaphene, 0·25 lb. mevinphos (Phosdrin), 0·375 lb. azinphos-methyl (Guthion), 0·5 lb. dimethoate, $1·6 \times 10^{11}$ polyhedra of the native polyhedrosis virus [*R.A.E.*, A **49** 353], an unspecified number of spores of *Bacillus thuringiensis* or combinations of toxaphene with the two pathogens, each at half the single rate. Control was evaluated by counts of surviving larvae after 5 and 7 days and by estimates of damage after 14 days.

After five days, all the other treatments were more effective than mevinphos; the two combinations resulted in the fewest survivors but were not significantly better than toxaphene or the bacillus used alone. After seven days, populations had increased in the plots treated with phosphorus insecticides, and slightly in those receiving the combination of toxaphene and the bacillus; the toxaphene-virus combination showed the lowest counts. These results were confirmed by the estimates of damage after 14 days, which showed the combination of toxaphene and virus to be significantly superior to all the other treatments, followed by toxaphene alone, the virus alone and the toxaphene-bacillus combination, in that order. The results are thought to show possibilities for both improved protection of the crop and delay in the development of resistance to insecticides.

Wilson (J. W.). **The performance of DDT for corn earworm control over an eleven year period.**—*Florida Ent.* **43** no. 2 pp. 69–75, 6 refs. Gainesville, Fla., 1960.

The results of tests conducted in 1949–59 for the control of the corn earworm [*Heliothis zea* (Boddie)] infesting sweet maize in Florida are described, and details are given of cultural practices and meteorological conditions that might have affected the control obtained, which varied considerably from year to year. The treatments were applied 3–11 times at intervals of 1–4 days, beginning with the first appearance of the tassels. Dusts of 3 and 5 per cent. DDT, used at rates of 20–50 lb. per acre, gave poor control in most years; 10 per cent. DDT dusts were usually effective. An emulsion concentrate containing 25 per cent. DDT, applied at 3–5 U.S. quarts, usually with mineral oil, in 30–140 U.S. gal. spray per acre, gave good control in most years. However, poor results were obtained with 3 U.S. quarts per acre in 1951 and with 5 U.S. quarts in 1954, 1957 and 1958; in the last two years, 10 per cent. dusts were also ineffective. Both dusts and sprays were effective in 1959, and it is concluded that resistance to DDT has not developed.

Hughes (I. W.). **Some natural enemies of the white peach scale,** *Pseudaulacaspis pentagona* **(Targioni) (Homoptera: Coccoidea) in Florida.**—*Florida Ent.* **43** no. 2 pp. 89–92, 1 fig., 9 refs. Gainesville, Fla., 1960.

The following is based on the author's summary. The natural enemies of *Pseudaulacaspis pentagona* (Targ.), which infests peach and numerous other plants, were investigated in northern Florida in 1959. Two parasites,

Prospaltella berlesei (How.) and *Aspidiotiphagus citrinus* (Craw), and three Coccinellid predators, *Chilocorus stigma* Say, *Lindorus lophanthae* (Blaisd.) and *Exochomus childreni* Muls. were observed. *P. berlesei* was itself parasitised by *Thysanus flavopalliatus* (Ashm.), which was common.

Whitcomb (W. H.) & Bell (R.). **Ground beetles on cotton foliage.**—*Florida Ent.* **43** no. 3 pp. 103–104, 5 refs. Gainesville, Fla., 1960.

Five species of the genus *Lebia* were found on the foliage of cotton in Arkansas in 1957–59. The most widely distributed was *L. analis* Dej., which was especially common in 1959. This Carabid is possibly at times an important predator of the eggs of *Heliothis zea* (Boddie), on which it fed freely in the laboratory; it did not attack aphids or the tarnished plant bug [*Lygus lineolaris* (P. de B.)], but ate the first-instar larvae of *H. zea*. *Lebia viridis* Say consumed eggs of *H. zea*, but less freely than did *L. analis*.

Peterson (A.). **A leaf skeletonizer, *Lobesia liriodendrana* (Kearfott), Olethreutidae, on *Magnolia grandiflora* in Florida.**—*Florida Ent.* **43** no. 3 pp. 105–114, 17 figs., 1 graph. Gainesville, Fla., 1960.

Observations are recorded on the bionomics and natural enemies of *Paralobesia* (*Lobesia*) *liriodendrana* (Kearfott), which was found infesting *Magnolia grandiflora* at Gainesville, Florida, in 1959, and the egg, larva and adult of this Tortricid are described. The eggs are laid on the upper surfaces of the leaves, and the larvae attack the undersides near the midrib. The larvae mine in the leaves in the first instar, and feed externally under a web, leaving the upper surfaces of the leaves intact, in the later ones. Pupation occurs in a cocoon under the web. The eggs were parasitised by *Trichogramma*, and miscellaneous predators attacked the larvae, affording considerable control.

Clarke (J. F. G.). **A new species of moth injurious to pine (Lepidoptera: Blastobasidae).**—*Florida Ent.* **43** no. 3 pp. 115–117, 5 figs. Gainesville, Fla., 1960.

Holcocera lepidophaga, sp. n., is described from adults of both sexes. This moth is widespread along the Atlantic seaboard of Florida, where considerable damage is done by the larvae to the flowers and young cones of *Pinus elliottii* and *P. palustris*. It also occurs in Massachusetts.

Guyer (G.), Hutson (R.) & Wells (A.). **The bionomics of a Coleophorid associated with asparagus spears.**—*Canad. Ent.* **92** no. 10 pp. 721–723, 3 figs., 1 ref. Ottawa, 1960.

Asparagus grown and received for processing in western Michigan in May 1959 was found to be heavily infested by larvae subsequently identified as *Coleophora amaranthella* Braun, which could not be dislodged by any of the various methods employed. The larvae were first reported on 6th May, when they were evidently in the final instar, and four of 14 fields examined about that date were extensively and five moderately infested; the rest were free from infestation, which appeared to be associated with the presence of weed débris. All the asparagus-growing areas of Michigan were surveyed between 8th and 20th May, and larvae were found in three other districts.

During the day, they migrated from spear to spear and fed somewhat, but they were of most economic importance when low temperatures caused them to crawl under the bracts and enter the heads. Many returned to the soil and entered broken asparagus stems of the previous year or crawled under stones and débris. Mevinphos (Phosdrin) and DDT at 0·33 and 1 lb., respectively, per acre were ineffective in controlling them. By 20th May, migration had ceased and larvae in the broken stems had pupated. Adults emerged in the laboratory on 3rd August, and there were extensive adult populations in many of the fields ten days later. Seed-heads of *Amarantus retroflexus* in one were heavily infested by larvae on 13th October, and large larval populations were found wherever this weed occurred in the district; many larvae were leaving the seed-heads and entering broken asparagus stems and débris. The larvae were associated with *Amarantus* in many areas of the Lower Peninsula during the autumn, and a programme for the eradication of the weed from asparagus fields was begun.

Martin (J. L.). **Life history of the pine tip moth,** *Rhyacionia adana* **Heinrich, in Ontario (Lepidoptera: Olethreutidae).**—*Canad. Ent.* **92** no. 10 pp. 724–728, 3 figs., 2 refs. Ottawa, 1960.

Rhyacionia adana Heinr., all stages of which are described, is thought to have been common in young pine plantations throughout southern Ontario for several years but to have been overlooked owing to confusion of the resultant damage with that due to *R. buoliana* (Schiff.). Its bionomics were investigated in 1957–59, and the following is largely based on the author's summary of the results. *R. adana* feeds on red pine (*Pinus resinosa*), jack pine (*P. banksiana*) and Scots pine (*P. sylvestris*) under about 3 ft. in height; in addition to Ontario, where it occurs throughout the south-eastern and central eastern region, it is known from Massachusetts, Virginia, Pennsylvania, Michigan and Wisconsin. The winter is passed in the pupal stage in a cocoon attached to the root collar of the tree immediately below the surface of the soil, and the adults emerge and the females oviposit in mid-April. The eggs are laid in groups of 1–4 on the needles, the first- and second-instar larvae mine in the needles and the rest of the larval period is spent in the shoots and buds, which may be destroyed. The larvae leave the buds to pupate in the soil in late June. While the larvae are still feeding, infested shoots appear somewhat stunted, but the needles continue to grow; when feeding ceases, the shoots eventually die, become brown and very brittle, and readily crumble. The egg parasite, *Trichogramma minutum* Ril., and two other Hymenopterous parasites that attack the larvae and caused 10–55 per cent. mortality among the prepupae and pupae in 1958 were reared from *R. adana*.

Mixed populations of *R. adana* and *R. buoliana* occur in young stands of *P. resinosa* in southern Ontario, and means of differentiating the two are described.

Sullivan (C. R.). **The effect of physical factors on the activity and development of adults and larvae of the white pine weevil,** *Pissodes strobi* **(Peck).**—*Canad. Ent.* **92** no. 10 pp. 732–745, 9 graphs, 11 refs. Ottawa, 1960.

The following is based on the author's conclusions from the results of quantitative studies on the influence of weather on the activity and development of *Pissodes strobi* (Peck) carried out in young stands of white pine

(*Pinus strobus*) in Ontario [*cf. R.A.E.*, A **48** 188]. Maximum activity of adults of the spring populations occurs on relatively clear, warm days during which bark temperatures reach 26–31°C. [78·8–87·8°F.] and relative humidities remain low. At lower temperatures, the amount of activity decreases, but remains relatively constant over the greater part of the normal range of relative humidity. At bark temperatures above the optimum level, the amount of activity drops rapidly, and there is none at bark temperatures of 35°C. [95°F.] and above; the lower limit of activity is 8°C. [46·4°F.]. Of the various classified types of activity studied, oviposition occurs within the narrowest limits of temperature and moisture, reaching its maximum at leader bark-temperatures of 25–29°C. [77–84·2°F.] in conjunction with relative humidities of 20–55 per cent. At lower temperatures and higher humidities, however, the amount of oviposition is reduced much more sharply than the amounts of feeding and pairing. Consequently, considerable feeding may occur during weather not conducive to oviposition. During the autumn, no well defined pattern of feeding occurs, but the adults prefer the leader and exposed parts of the laterals of the upper three whorls of the trees when the weather permits feeding there. The amount of feeding by the adults is influenced chiefly by temperature and less by changes in atmospheric moisture and solar radiation, because feeding may continue in shaded parts of the habitat where the temperatures are not extreme. The rate of feeding by the larvae is related to the temperature of the bark. At the higher temperatures, the larvae consume more food and hence move down the stems more rapidly. Observations showed that survival of individual populations of larvae depends not only on temperature, but also on their size and their distribution within individual stems.

Smith (D. S.). **Survival of unfed first-instar grasshoppers.**—*Canad. Ent.* **92** no. 10 pp. 755–756, 1 graph, 7 refs. Ottawa, 1960.

Newly hatched nymphs of *Camnula pellucida* (Scud.) and *Melanoplus bilituratus* (Wlk.) survived in the laboratory without food for up to eight days at 20°C. [68°F.], up to five days at 25°C. [77°F.] and up to four days at 30°C. [86°F.]. Others provided with cut seedling wheat leaves began feeding as soon as eight hours after hatching at 30°C. and as late as 48 hours at 20°C. Most grasshoppers that hatch 75 yards or more from food are likely to die of starvation [*cf. R.A.E.*, A **44** 110], and this may occur where all plants have been destroyed by cultivation. Control by bare cultivation is less likely to be effective against the later instars, owing to their increased rate of dispersal [*loc. cit.*].

Wood (G. W.). **Note on the occurrence of two species of thrips (Thysanoptera: Thripidae) on low-bush blueberry in New Brunswick and Nova Scotia.**—*Canad. Ent.* **92** no. 10 pp. 757–758, 4 figs., 2 refs. Ottawa, 1960.

Low-bush blueberries in New Brunswick were known since 1947 to be infested by *Frankliniella vaccinii* Morg. [*cf. R.A.E.*, A **46** 193], but examples collected during the summer of 1958 were found to include also *Taeniothrips vaccinophilus* Hood. Re-examination of specimens collected there before 1958 established that all obtained between 1947 and 1951 and about 75 per cent. of those obtained in 1951 were referable to *F. vaccinii*, but that those collected since 1951 were mostly *T. vaccinophilus*. In 1959, *T. vaccinophilus* was predominant in Charlotte County and approximately equal in abundance

to *F. vaccinii* in the north and east of the Province, but *F. vaccinii* was ten times as numerous in two collections from adjacent areas of Nova Scotia. It is therefore concluded that *T. vaccinophilus*, which was described from blueberry in New York, entered the area from the United States and is spreading eastward. The life-cycles of the two species are similar. Overwintered females leave the soil and attack the plants in late May or early June. The eggs are laid within the leaves, and nymphal development takes place in leaf galls [*cf.* **31** 11]; both species may occur in the same gall. Development is completed in late July or August. The adults enter the soil by late September, and the males die in late autumn or winter. Characters for separating the adults of the two species are noted.

Cartier (J. J.). **Growth, reproduction and longevity in one biotype of the pea aphid,** *Acyrthosiphon pisum* **(Harr.) (Homoptera: Aphididae).**—*Canad. Ent.* **92** no. 10 pp. 762–764, 1 graph, 7 refs. Ottawa, 1960.

One of three lines of *Macrosiphum* (*Acyrthosiphon*) *pisum* (Harris) reared on pea in Quebec [*cf. R.A.E.*, A **48** 297] was adopted as a standard culture for studies on aphid resistance in peas, and, since the weight of individual aphids is often the criterion employed in measuring resistance, the growth, reproduction and survival of this line were studied. The following is based on the author's summary of this account of the work. Weight variations were measured at 69 ± 2°F. In each instar, the nymphs slightly more than doubled their weight and interrupted their feeding 6–9 hours before moulting. After a pre-reproduction period of 43 hours from the last moult, the apterous virginoparae produced an average of 106·3 nymphs in a 20-day reproduction period. During the first eight days, the daily production of nymphs was equivalent to 24 per cent. of the weight of the female. The females remained ten days in a post-reproduction stage and died on the 39th day.

Perron (J. P.), Jasmin (J. J.) & Lafrance (J.). **Attractiveness of some onion varieties grown in muck soil to oviposition by the onion maggot** (*Hylemya antiqua* **(Meig.)) (Anthomyiidae: Diptera).**—*Canad. Ent.* **92** no. 10 pp. 765–767, 3 refs. Ottawa, 1960.

The following is based almost entirely on the authors' summary. Further field and greenhouse tests of seven varieties of onions grown in muck soils in Quebec in 1957–58 [*cf. R.A.E.*, A **48** 68] showed that two varieties of *Allium fistulosum* were much less attractive to ovipositing females of *Hylemyia antiqua* (Mg.) than four of *A. cepa* (true onion). A named hybrid of the two species was intermediate in attractiveness between the two groups, particularly in greenhouse tests.

Herne (D. H. C.) & Putman (W. L.). **Notes on the life-history and habits of the brown mite,** *Bryobia arborea* **Morgan & Anderson (Acarina: Tetranychidae), on peach in Ontario.**—*Canad. Ent.* **92** no. 10 pp. 775–779, 1 graph, 5 refs. Ottawa, 1960.

Bryobia rubrioculus (Scheuten) (*arborea* Morgan & Anderson) [*cf. R.A.E.*, A **49** 249] is of little economic importance on fruit trees in Ontario, although examples collected on peach, plum, cherry and apple in the Niagara Peninsula were stated by Morgan to be morphologically identical with those occurring in British Columbia [*cf.* **47** 118]. Information on the bionomics of

the mite on peach in Ontario obtained in 1956–59 is here given, and compared with that reported from British Columbia [**47** 238] and the United States [**13** 506; **39** 332]. The following is virtually the authors' summary. The mite has four and, in some seasons, possibly five generations a year in Ontario. Some females of most, and possibly all, generations lay diapause eggs that do not hatch until the following spring. Most individuals rest, moult and oviposit on the bark of the twigs, and feed almost entirely on the leaves near the base of the shoots. This restriction of activity and loss of eggs through fall of old bud scales and other plant parts may help to limit the numbers of the mite on peach trees. Although the habits differ slightly, the mite on peach in Ontario is considered conspecific with that on apple in British Columbia.

Brown (N. R.) & Clark (R. C.). **Studies of predators of the balsam woolly aphid, *Adelges piceae* (Ratz.) (Homoptera: Adelgidae). VIII. Syrphidae (Diptera).**—*Canad. Ent.* **92** no. 11 pp. 801–811, 18 figs., 9 refs. Ottawa, 1960.

The following is based almost entirely on the authors' summary of this part of a series on the predators of *Chermes* (*Adelges*) *piceae* Ratz. on balsam fir [*Abies balsamea*] in eastern Canada [*cf. R.A.E.*, A **49** 400]. Characters are given for the field identification of most stages of *Syrphus torvus* O.-S., *Metasyrphus lapponicus* (Zett.) and *Neocnemodon coxalis* (Curr.), three native Syrphid predators that are common in New Brunswick, and their seasonal life-cycles are summarised in relation to that of *C. piceae*. All are bivoltine, but in all three only one generation feeds extensively on *C. piceae*; *S. torvus* and *M. lapponicus* both attack the hiemosistens generation in early summer, and *N. coxalis* the aestivosistens generation in late summer and autumn. Populations of the three Syrphids varied greatly from year to year and place to place with no clear relation to prey density. Their feeding habits limit their capacity to control *C. piceae*. They reduce the rate of increase, but cannot reverse the upward trend of the population in the summer generation unless other factors are also present. They were attacked by eight parasite species, of which only *Diplazon* (*Syrphoctonus*) *agilis* (Cress.) parasitised all three. The larvae of three undetermined Syrphid species that occasionally prey on *C. piceae* are briefly described, and five species of which the adults have been collected on trees infested by *C. piceae* are listed. Two European species, *N. latitarsis* (Egg.) and *N. pubescens* (Delucchi & Pschorn-Walcher), were released in New Brunswick in 1954, but neither has been recovered.

Gardiner (L. M.). **Descriptions of immature forms and biology of *Xylotrechus colonus* (Fab.) (Coleoptera: Cerambycidae).**—*Canad. Ent.* **92** no. 11 pp. 820–825, 15 figs., 8 refs. Ottawa, 1960.

Xylotrechus colonus (F.) was found infesting logs of red oak [*Quercus rubra*] in Quebec and bolts of yellow and white birch [*Betula alleghaniensis* and *B. papyrifera*] in Ontario, and its bionomics were studied in Quebec. The first-instar larva and pupa of the Cerambycid are described, and a description of the mature larva quoted. The adults emerged in late June and August and were not observed to feed on the sugar and water and birch foliage provided in the cages. Eggs were laid in groups of 1–6 under rough bark scales or on the lower side of shreds of outer bark and, in red oak and, sometimes, yellow birch, in the inner bark of cut ends. The larvae

hatched in about three weeks and fed on the inner bark; the type of gallery formed varied with tree species. Pupation took place in shallow cells in the sapwood in red oak and, to some extent, white birch, and at the end of the gallery in the inner bark in yellow birch. Development was completed in about 23 months. All three timbers were infested in the field, but where white and yellow birch were present in the same pile only the latter was attacked. Infestation in white birch was always light. Since feeding is largely restricted to the inner bark, *X. colonus* is unlikely to be of economic importance in hardwood logs, though it may facilitate the entry of fungi. Pupae of the Braconid, *Helconidia ligator* (Say), were found in the pupal chambers, and a few larvae and pupae of *X. colonus* were attacked by the fungus, *Isaria farinosa*.

Hedlin (A. F.). **On the life history of the Douglas-fir cone moth,** *Barbara colfaxiana* **(Kft.) (Lepidoptera: Olethreutidae), and one of its parasites,** *Glypta evetriae* **Cush. (Hymenoptera: Ichneumonidae).**—*Canad. Ent.* **92** no. 11 pp. 826–834, 11 figs., 10 refs. Ottawa, 1960.

Barbara colfaxiana (Kearfott) [*cf. R.A.E.*, A **42** 307], which occurs throughout the range of Douglas fir [*Pseudotsuga menziesii*] in British Columbia, the Pacific Coast States of the United States and the Rocky Mountains, has damaged cones and seeds of this tree for a number of years, causing seed losses varying from slight to almost 100 per cent. The following is based almost entirely on the author's summary of this account of observations on its bionomics made in Vancouver Island and the interior of British Columbia in 1957–59. The females oviposit on the bracts of cones throughout the height of the tree during April and May. The larvae hatch in 2–3 weeks and enter the cones at the angle between a bract and a scale in Vancouver Island and into any part of the scale, sometimes passing through the bract immediately above it, inland, to feed on the scales and seeds. The larvae feed from early May to about mid-July and pass through four instars. A single larva in a cone destroyed an average of 65 per cent. of the seeds; multiple infestations caused heavier losses. Pupation takes place in a cocoon in the feeding tunnel within the cone in July, and the adults emerge in the following spring, when the young cones are developing, though some pupae may remain in diapause for at least another year. Several parasites were reared, of which the most important was *Glypta evetriae* Cushm. Females of this Ichneumonid oviposited in early-instar host larvae, which continued to develop until they had constructed their cocoons and then died immediately. A few adults emerged during autumn of the same year, but most of the parasites overwintered as larvae in the host cocoons and gave rise to adults in the following spring.

Rivard (I.). **A technique for individual rearing of the predacious mite** *Melichares dentriticus* **(Berlese) (Acarina: Aceosejidae) with notes on its life history and behaviour.**—*Canad. Ent.* **92** no. 11 pp. 834–839, 2 figs., 8 refs. Ottawa, 1960.

The following is based largely on the author's summary. Techniques are described for rearing the predacious mite, *Melichares dentriticus* (Berl.), individually on various stages of *Tyrophagus putrescentiae* (Schr.) [*cf.* also *R.A.E.*, A **49** 399]. When only eggs were provided, a cell similar to one already described [**33** 77] proved satisfactory, but, when active stages were used, the micro-cell developed by Rivard [**47** 441], but with a larger rearing

chamber, was employed. The predator apparently searches at random and attacks any stage of its prey. It feeds primarily on the larvae and protonymphs and is occasionally cannibalistic. The number of prey consumed varies with the size and stage of both prey and predator. At 72°F. and 80 per cent. relative humidity, development of the male and female was completed in nine and ten days, respectively, on a diet of larvae and 11 and 15 days on eggs. Only mated females laid eggs, and oviposition began 3–5 days after mating. Eggs were usually laid singly at intervals of 2–3 days, and the females lived for an average of about seven weeks. Some evidence was obtained that the predator cannot develop or reproduce in the absence of prey, but it will probably survive for longer if mould is available than in the absence of any food.

Miller (C. A.). **The interaction of the spruce budworm,** *Choristoneura fumiferana* **(Clem.), and the parasite** *Glypta fumiferanae* **(Vier.).**—*Canad. Ent.* **92** no. 11 pp. 839–850, 4 graphs, 16 refs. Ottawa, 1960.

The following is based partly on the author's conclusions in this second paper of a series dealing with the interaction of primary parasites and *Choristoneura fumiferana* (Clem.) on spruce and balsam fir [*Abies balsamea*] in Canada [*cf. R.A.E.*, A **48** 520]. The analysis of data obtained from field plots in the course of long-term studies on the population dynamics of *C. fumiferana* [*cf.* **48** 141] in north-western New Brunswick during an outbreak in 1947–58 showed that the effect of the primary parasite, *Glypta fumiferanae* (Vier.), is described by K. E. F. Watt's model of predator-prey interaction [**48** 520] and adds further support to the general application of the model in describing field data. The refined model for *G. fumiferanae* contains a modification to express the effect of defoliation (which, when severe, appeared to lower the efficiency of attack by the parasite) on the attack coefficient. The analysis also suggests that extremes in weather conditions may lessen attack efficiency. Observations on caged adults indicated that *G. fumiferanae* attacks first- and second-instar larvae of *C. fumiferana* in hibernacula. Winter is passed in the first larval instar, and the parasite emerges from host larvae in the fifth or sixth instar. Average survival from egg to cocoon was 16 per cent. The females survived for about 30 days. Parasitism by this species was less severe in heavy than in moderate infestations of *C. fumiferana*.

Peterson (L. O. T.). *Lecanium coryli* **L. (Homoptera: Coccoidea) in Saskatchewan.**—*Canad. Ent.* **92** no. 11 pp. 851–857, 10 refs. Ottawa, 1960.

The following is based almost entirely on the author's summary. An outbreak of *Eulecanium* (*Lecanium*) *coryli* (L.) on American elm (*Ulmus americana*) in two districts in south-eastern Saskatchewan was investigated in 1957–59, when data on seasonal occurrence, bionomics and natural mortality were obtained and experiments on chemical control conducted. The nymphs overwintered on the trunks and branches and reappeared in spring between 1st April and 9th May. Some females had begun to oviposit by late May. Hatching began in late June, and first-generation nymphs appeared on the foliage by early July. Migration from the leaves to the branches and trunks occurred from late August to early November. Physical factors killed 67 per cent. of nymphs overwintering on the trunks, 70 per cent. of those overwintering on the ends of the branches, up to 35 per cent.

of nymphs that survived the winter, and up to 37 per cent. of first-generation nymphs on the leaves. A small proportion of the population persisted during much of the season as underdeveloped nymphs [*cf. R.A.E.*, A **42** 221]. Twelve species of parasites were reared from the adult females, and parasitism ranged from 5 to 43 per cent. In experiments on control, high-volume emulsion sprays of malathion, diazinon, summer oil and a light miscible petroleum oil were ineffective against the spring and early-summer stages, but sprays of 50 per cent. malathion or 25 per cent. diazinon at 2 quarts per 100 gal. water were effective against the stages on the leaves.

Béique (R.). **The importance of the European pine shoot moth,** *Rhyacionia buoliana* **(Schiff.) in Quebec City and vicinity.**—*Canad. Ent.* **92** no. 11 pp. 858–862, 9 refs. Ottawa, 1960.

The following is based largely on the author's conclusions. An investigation of the effectiveness of natural factors in controlling *Rhyacionia buoliana* (Schiff.) was made in 1955–59 near Quebec City, where small areas of infestation were discovered on mugho pine (*Pinus mugo*) in 1954. The results showed that over 60 per cent. of the larvae were parasitised and that *Orgilus obscurator* (Nees) was responsible for over 85 per cent. of the parasitism. This European Braconid, which is not known to have been released in the Province, is well established and more effective than elsewhere in Canada, where parasitism by it seldom exceeds 12 per cent. *R. buoliana* is also killed by severe cold, and when snowfall is light or occurs late in the season, larval mortality is high. In Ontario and the northern United States, it not infrequently reaches 65–85 per cent., but, in Quebec, all larvae above snow level are killed. This provides good protection for pine trees in plantations, and infestation was consequently confined to small ornamental trees in gardens and nurseries. It is concluded that *R. buoliana* is unlikely to become of economic importance in the Province.

Embree (D. G.). **Observations on the spread of** *Cyzenis albicans* **(Fall.) (Tachinidae: Diptera), an introduced parasite of the winter moth,** *Operophtera brumata* **(L.), (Geometridae: Lepidoptera) in Nova Scotia.**—*Canad. Ent.* **92** no. 11 pp. 862–864, 3 refs. Ottawa, 1960.

Parasitism of *Operophtera brumata* (L.) by *Monochaeta* (*Cyzenis*) *albicans* (Fall.) was investigated in 1958 and 1959 in an area (Oak Hill) in Nova Scotia where the parasite had been released yearly from 1954 to 1957 [*cf. R.A.E.*, A **48** 65]. Samples of larvae were taken from the trees by a method already described [**44** 227] at the liberation site and in eight plots of which the most distant was 1·2 miles away. In 1958, parasitism reached 9 per cent. at the release site and 3 per cent. in a plot half a mile distant; by 1959, it had increased in these two plots to 24 and 10 per cent., respectively, and had extended to all but one of the other plots, in which it varied from 4 to 19 per cent. Mature host larvae were dissected in 1959, but accurate estimates of parasitism were not obtained, owing to difficulty in detecting the parasite larvae, which remain in the first instar until the host pupates; superparasitism occurred in 18·5 per cent. of the host larvae, and 22 per cent. that were parasitised by *M. albicans* also contained a nematode tentatively identified as *Complexomermis* sp. The degree of parasitism apparently depended largely on distance from the liberation site, and host density had not yet become of importance. Parasitism increased each year at the release site, and it was more than twice as high in 1959 as in 1958, despite a 75 per

cent. decrease in the host population, so that it had probably not yet reached a peak. G. Varley showed that, in England, *O. brumata* is most heavily parasitised when it is numerous and that *M. albicans* is ineffective when host populations are low; host populations were only moderately high in the present studies, however, and from the degree of parasitism attained, it is thought that *M. albicans* may be more effective in Nova Scotia than it is in England. Life-table studies showed that, before the establishment of *M. albicans*, populations of *O. brumata* fluctuated considerably from year to year, corresponding with changes in mortality among the first-instar larvae. This mortality depends on the degree of synchronisation between hatching and bud burst, and the fluctuations are therefore largely a matter of chance, with food supply as the density-dependent factor determining the upper limits.

Hobbs (G. A.), Virostek (J. F.) & Nummi (W. O.). **Establishment of *Bombus* spp. (Hymenoptera: Apidae) in artificial domiciles in southern Alberta.**—*Canad. Ent.* **92** no. 11 pp. 868–872, 1 fig., 7 refs. Ottawa, 1960.

An account is given of investigations in southern Alberta in which bumble bees (*Bombus* spp.) were found to colonise small boxes lined with upholsterers' cotton placed on the ground in suitable situations in spring. The species attracted included locally important pollinators of red clover [*Trifolium pratense*], but not those of lucerne, which apparently prefer to nest below ground.

Paim (U.) & Beckel (W. E.). **A practical method for rearing *Monochamus scutellatus* (Say) and *M. notatus* (Drury) (Coleoptera: Cerambycidae).** —*Canad. Ent.* **92** no. 11 pp. 875–878, 4 figs., 3 refs. Ottawa, 1960.

The following is substantially the authors' summary. The observed tendency of *Monochamus* larvae to avoid contact with the extra-cortical environment was successfully utilised to make rearing chambers of natural bark of white pine [*Pinus strobus*] in which implanted larvae of *M. scutellatus* (Say) and *M. notatus* (Dru.) were isolated on one side by the normal thickness of the bark and on the other by a transparent coating of vinyl plastic, replacing the sapwood. Pieces of whole white-pine bark were used to construct the chambers, 6 × 12 in. in size, and were coated twice on the inner surface with a proprietary solution of vinyl plastic in acetone. One larva was introduced into each slab of coated bark. The slabs were suspended over water in glass jars and required no subsequent handling until the completion of the life-cycle. The larvae mined in the inner bark next to the plastic film, never becoming obscured from view; they constructed their pupal chambers in the bark, and most of the adults emerged through the outer bark.

Miller (W. E.). **Unusual occurrence of the Virginia pitch-nodule moth, *Petrova wenzeli* (Kearfott), in Canada (Lepidoptera: Olethreutidae).** —*Canad. Ent.* **92** no. 11 p. 879, 2 refs. Ottawa, 1960.

Examination of specimens from Ontario tentatively identified as *Petrova albicapitana* (Busck) in the Canadian National Collection and the collection of the Canadian Forest Insect Survey showed that five were referable to *P.*

wenzeli (Kearfott), and this species comprised about 3 per cent. of a large group, subsequently reared, of which the rest were *P. albicapitana*. In Ontario, *P. wenzeli* feeds on jack pine (*Pinus banksiana*), and the localities from which it was obtained are 100–250 miles distant from the limit of the range of its normal food-plant, Virginia pine (*P. virginiana*), outside which it has not previously been recorded. Its life-cycle resembles that of *Petrova albicapitana* [*cf. R.A.E.*, A **42** 400], and characters are given for the separation of the adults of the two species.

Lewis (F. B.). **Factors affecting assessment of parasitization by** *Apanteles fumiferanae* **Vier. and** *Glypta fumiferanae* **(Vier.) on spruce budworm larvae.**—*Canad. Ent.* **92** no. 12 pp. 881–891, 13 refs. Ottawa, 1960.

Apanteles fumiferanae Vier. and *Glypta fumiferanae* (Vier.) both attack the larvae of *Choristoneura fumiferana* (Clem.) in late summer, before the latter hibernate, but evidence obtained in northern Maine in 1950–51 indicated that parasitism by these species was apparently higher in fourth-instar larvae than in second-instar larvae that had just left hibernation. The significance of this and other observed differences in degree of parasitism depending on the manner and timing of sampling [*cf. R.A.E.*, A **43** 54] was accordingly investigated, and the following is based on the author's summary of the results. Laboratory studies of oviposition behaviour in the two parasites showed that *Apanteles* is more efficient when attacking mobile host larvae and *Glypta* when attacking immobile host larvae in their hibernacula. Only one parasite of either species can survive in a single host. Larvae of *Apanteles* inhibited the development of eggs of *Glypta*, and this effect was more pronounced as the interval between oviposition by the two parasites lengthened. Observations that unparasitised larvae of *C. fumiferana* are strongly photopositive [*cf.* **38** 4, 98] were confirmed, but larvae parasitised by *Apanteles* or *Glypta* were found to react negatively or not at all to light. Parasitised larvae left their hibernacula as much as a week to ten days later than unparasitised ones. The difference between percentage parasitism in collections of hibernating and bud-mining larvae was found in laboratory studies and field observations on balsam fir (*Abies balsamea*) in 1955–56 to be real and significant. It is due primarily to differential loss of unparasitised larvae in the period from emergence from hibernation to establishment of feeding sites on the buds, which in turn is related to the different patterns of movement of parasitised and unparasitised individuals on the trees. Unparasitised larvae move from hibernation to the terminal portions of the branches earlier and in greater proportion than parasitised larvae. No significant difference was found in percentage parasitism on terminal, 15-in. twigs and the rest of the branch [*cf.* **48** 140] in samples collected either immediately after hibernation or when the larvae were mining in the buds. It is concluded that methods of forcing larvae of *C. fumiferana* out of hibernation result in biased data on parasitism.

Stairs (G. R.). **Infection of the jack pine budworm,** *Choristoneura pinus* **Freeman, with a nuclear polyhedrosis virus of the spruce budworm,** *Choristoneura fumiferana* **(Clemens), (Lepidoptera: Tortricidae).**—*Canad. Ent.* **92** no. 12 pp. 906–908, 6 refs. Ottawa, 1960.

In experiments in 1958 and 1959, in which larvae of *Choristoneura pinus* Freeman in the fifth and early sixth instar collected on jack pine [*Pinus banksiana*] in southern Manitoba and more mature larvae from north-western

Ontario were given heavy oral doses of a suspension of a nuclear polyhedral virus isolated from *C. fumiferana* (Clem.) [*cf. R.A.E.*, A **43** 303; **49** 17] and containing about 10×10^7 polyhedra per ml. water or were allowed to feed on foliage of balsam fir [*Abies balsamea*] that had been dipped in a similar suspension at a concentration of 10×10^6 polyhedra per ml., combined mortality among larvae and pupae amounted to 41·9 and 46·4 per cent., respectively. Mortality among larvae of *C. fumiferana* that ingested the virus amounted to 62·5 per cent., and it was 41·7 and 54·2 per cent. among two groups ingesting virus propagated in *C. pinus*.

Smirnoff (W. A.). **Observations on the migration of larvae of** *Neodiprion swainei* **Midd. (Hymenoptera: Tenthredinidae).**—*Canad. Ent.* **92** no. 12 pp. 957–958. Ottawa, 1960.

Mass migrations of larvae of *Neodiprion swainei* (Middleton) have not hitherto been reported, but were observed in Quebec in 1958 and 1959, when many stands of jack pine (*Pinus banksiana*) that were lightly infested in early summer were completely defoliated by August, mostly within a fortnight. The larvae on defoliated trees congregated at the top and after several days left in search of food. The migrating larvae were pale yellow in colour and were able to infest trees 200 yards or more distant, after which they recovered their original dark green hue. Newly infested trees were readily distinguished by the absence or scarcity of egg scars on needles of the current growth, defoliation first appearing in the lower crown, and the large size of the colonies, which consisted of 120–170 individuals instead of the normal 40–70.

Larvae infected with virus also migrated, usually in the third, fourth and fifth instars, in which the incubation period of the disease is longer than in the earlier ones. After wandering aimlessly, they gathered on branches receiving the most light, then three or four days later began moving in specific directions, settling on partly defoliated trees, and finally fell to the ground, where they either died or began constructing cocoons prematurely. They survived for up to 20 days before succumbing. The virus was found to be localised in the nuclei of a few cells in the mid-gut epithelium and developed very slowly. Some infected larvae completed development, and the females transmitted the disease to their progeny. By disseminating the disease, mass migrations increase its efficiency as a natural control factor.

Swailes (G. E.). **Laboratory evaluation of resistance in rutabaga varieties to the cabbage maggot,** *Hylemya brassicae* **(Bouché) (Diptera: Anthomyiidae).**—*Canad. Ent.* **92** no. 12 pp. 958–960, 2 refs. Ottawa, 1960.

The following is based almost entirely on the author's summary of this account of further investigations in Alberta on varietal resistance to *Hylemyia brassicae* (Bch.) in swedes [*cf. R.A.E.*, A **49** 191]. A method is described for rearing larvae individually on root cores of swede in vials; 60–81 per cent. of 1,020 larvae reared on 12 varieties in 1958 and 77–92 per cent. of 600 reared on six of them in 1959 pupated. The similarity of pupal weights and duration of larval periods suggested that, once established, the larvae are sustained equally well on all varieties. Cortex tissue seemed less favourable, but in a variety on which there was only 3–4 per cent. survival from the egg to the pupal stage in earlier field tests [*loc. cit.*], survival rates of 66 and 92 per cent. on root cores were obtained in the two years and there was 63 per cent. establishment on cortex tissue. This indicated that the

low survival observed in the field resulted from resistance to the initiation of feeding. Survival of larvae on another variety was low in all tests because of the failure of the larvae to establish themselves on the root cores and because of relatively high mortality in the second and third instars.

Mason (W. R. M.). **Some new Braconidae (Hymenoptera).**—*Canad. Ent.* **91** no. 1 pp. 42–50, 16 figs. Ottawa, 1959. **New Ichneumonidae (Hymenoptera) from tamarack.**—*Op. cit.* **93** no. 1 pp. 3–7, 3 figs. 1961.

Walley (G. S.). **A new *Pimplopterus* parasite of *Argyresthia laricella* (Hymenoptera: Ichneumonidae).**—*T.c.* pp. 1–3.

The five new species of Braconids described in the first paper are *Apanteles salalicus* from *Lithocolletis gaultheriella* Wlsm. on *Gaultheria shallon* [*cf. R.A.E.*, A **4** 6] in Oregon, *A. salicifoliellae* from *L. salicifoliella* Chamb. on aspen (*Populus tremuloides*) in Ontario [*cf.* **45** 487], *A. laricellae* from *Argyresthia laricella* Kearfott on tamarack (*Larix laricina*) in New Brunswick and Ontario [see next abstract], *Apanteles enypiae* from *Enypia venata* (Grote) on Douglas fir [*Pseudotsuga menziesii*] and hemlock [*Tsuga*] in British Columbia, and *Chelonus phaloniae* from *Phalonia hospes* (Wlsm.) on sunflower [*Helianthus*] in Manitoba [*cf.* **40** 59].

Two new species of Ichneumonids reared during 1957–59 from *Argyresthia laricella* on tamarack are described in the second paper. They are *Phaeogenes laricellae* from New Brunswick and Ontario and *Alegina laricellae* from New Brunswick, Prince Edward Island and Ontario. The new Ichneumonid species described in the third paper is *Pimplopterus argyresthiae*, which was reared from the same host during the same period in Nova Scotia, New Brunswick, Quebec and Ontario.

Eidt (D. C.) & Sippell (W. L.). **The life history, parasites, and economic status of the larch shoot moth, *Argyresthia laricella* Kft. (Lepidoptera, Yponomeutidae), and comparisons with *A. laevigatella* H.-S.**—*Canad. Ent.* **93** no. 1 pp. 7–24, 18 figs., 24 refs. Ottawa, 1961.

Eidt (D. C.). **The morphology of the larch shoot moth, *Argyresthia laricella* Kft. (Lepidoptera: Yponomeutidae), and comparisons with *A. laevigatella* H.-S.**—*T.c.* pp. 24–32, 32 figs., 11 refs.

The following is based almost entirely on the authors' summary of the first paper. *Argyresthia laricella* Kearfott is known from every Province of Canada except Saskatchewan and occurs on tamarack (*Larix laricina*), European larch (*L. decidua*) and western larch (*L. occidentalis*). The eggs are laid at the bases of the shoots in early summer. The larvae feed within the shoots, overwinter, and pupate between late April and late June, depending on the locality. The moths appear 3–4 weeks later. Some 15 species of parasites were reared from the Hyponomeutid, of which *Alegina laricellae* Mason, *Apanteles laricellae* Mason, *Phaeogenes laricellae* Mason and *Pimplopterus argyresthiae* Walley [*cf.* preceding abstract] appear to be important. Because its numbers are generally low and the leaders are seldom attacked, *Argyresthia laricella* is not economically important. Its bionomics are compared with those of *A. laevigatella* (H.-S.) [*cf. R.A.E.*, A **31** 83], which occupies an equivalent ecological niche on larch in Europe, and it is suggested as a source of parasites for introduction against *A. laevigatella*; it is also of potential importance as a subject for the study of population dynamics.

In the second paper, the egg, last-instar larva, pupa and adult are described and compared with those of *A. laevigatella* from various European countries, and it is concluded that the two species are closely related.

Bugbee (R. E.). **A new species of the genus** *Eurytoma* (**Hymenoptera: Eurytomidae**) **phytophagous in the buds of jack pine** (*Pinus banksiana*). —*Canad. Ent.* **93** no. 1 pp. 33–34. Ottawa, 1961.

Thomas (J. B.) & Herdy (H.). **A note on** *Eurytoma calycis* **Bugbee** (**Hymenoptera: Eurytomidae**) **occurring in shoots of jack pine** (*Pinus banksiana* (**Lamb.**)).—*T.c.* pp. 34–39, 7 figs., 10 refs.

In the first of the papers, *Eurytoma calycis*, sp. n., is described from adults of both sexes reared from buds of jack pine (*Pinus banksiana*) in north-western Ontario in 1958. In the second, the immature stages are described, and observations on the bionomics of the Eurytomid are recorded. Shoots containing overwintering larvae were distinguished in early May by their retarded growth; furthermore, they often became slightly swollen and bent as spring growth began. In summer, newly infested shoots could not be distinguished. The overwintered larvae pupated in separate mines in the woody tissues of shoots of the current year. The pupal stage lasted 10–14 days, and emergence in 1957–59 began about the end of May or early June and continued until mid-June or early July. Oviposition was not observed, but probably occurs immediately after adult emergence, which coincides with rapid shoot elongation; adults were observed on newly formed buds, but females did not oviposit in buds in cages. Larval development is probably completed by winter, and there are at least four instars. The larvae feed on plant tissues during the latter part of their development and some, at least, may be entirely phytophagous, though the remains of other insects were found in faecal deposits and in one infested shoot.

Tripp (H. A.). **The biology of a hyperparasite,** *Euceros frigidus* **Cress. (Ichneumonidae) and description of the planidial stage.**—*Canad. Ent.* **93** no. 1 pp. 40–58, 21 figs., 20 refs. Ottawa, 1961.

The bionomics of the hyperparasite, *Euceros frigidus* Cress., were investigated in Quebec during studies on the parasites of *Neodiprion swainei* (Middleton) on jack pine (*Pinus banksiana*) [*cf. R.A.E.*, A **49** 479], and the following is based on the author's summary of the results. The eggs have stalks and are deposited during July in groups of about 100 on the foliage and stems of jack pine at a distance of about 4 in. from a colony of young larvae of *N. swainei*. The first-instar larva (planidium) attaches itself to the integument of a sawfly larva, which may bear several and serves as a carrier and a source of nourishment until the following spring. Contact is then made with one of the primary parasites, *Olesicampe lophyri* (Ril.), *Lamachus* sp. and *Endasys subclavatus* (Say). These attack *N. swainei* and are the true hosts of *Euceros frigidus*; their bionomics are outlined. The hyperparasite probably passes through 7–8 larval instars, of which four are endoparasitic and the rest ectoparasitic. The adult emerges from the cocoon of *N. swainei* in July. The paper includes descriptions of the egg before and after deposition, of the planidium and of characters distinguishing the stalked egg from similar Chrysopid eggs and the planidium from larvae of other insect orders to which it bears a superficial resemblance. Other sawfly larvae [*cf.* **48** 523] and Lepidopterous larvae are also stated to serve as carriers of the planidia, which then attack other primary parasites.

Guppy (J. C.). **Life-history, behaviour, and ecology of the clover seed midge,** *Dasyneura leguminicola* **(Lint.) (Diptera: Cecidomyiidae), in eastern Ontario.**—*Canad. Ent.* **93** no. 1 pp. 59–73, 4 figs., 23 refs. Ottawa, 1961.

The following is based almost entirely on the author's summary. Field studies on *Dasyneura leguminicola* (Lint.) attacking red clover (*Trifolium pratense*) grown for seed in eastern Ontario in 1952–59 showed that about half the first-generation larvae gave rise to a second generation, of which the full-fed larvae hibernated. The other half also hibernated as full-fed larvae, a few remaining dormant for up to three years. Adults paired in the morning at temperatures of 68–72°F. Egg-laying began a little later and continued throughout the day at temperatures above 70°F. Females distributed their eggs among many clover heads, including some that already contained eggs. In a field cage, males survived for 0·5–1·5 days; mated females lived for 0·5–2·5 days and laid an average of 96 eggs each. In July and August, the incubation period of 560 eggs averaged 2·4 days. Within 24 hours, the newly hatched larvae entered the green florets through the folded petals and fed for 11–16 days. The full-fed larvae dropped from the florets when the heads were moistened by rain or dew and made cocoons, usually just below the surface of the soil. The duration of the larval stage in the first generation was 50–60 days for non-hiberating larvae and about 345 days for most of the hibernating ones; second-generation larvae pupated in about 275 days. The pupal stage averaged 14 days.

Overwintered first- or second-generation larvae pupated in mid-May. Most of the adults emerged in late May and early June and laid eggs in the first growth of red clover. Full-fed larvae began dropping to the ground about 20th June, and most non-hibernating larvae had pupated by 14th August. First-generation adults emerged in late July and August, and eggs were laid in the second growth of red clover. In August and early September, the clover heads contained second-generation larvae in all stages of growth, and the full-fed larvae began dropping to the ground about 20th August. Red clover was the only food-plant of the Cecidomyiid in eastern Ontario.

Six species of Hymenopterous parasites were reared from the larvae, *Pseudotorymus lazulellus* (Ashm.), *Tetrastichus nebraskensis* (Gir.), *T. pausiris* (Wlk.), *Ceraphron* sp., *Conostigmus* sp. and *Platygaster* sp. They had apparently not previously been recorded attacking *D. leguminicola*, and *T. pausiris* had not previously been recorded from North America.

Sullivan (C. R.). **The survival of adults of the white pine weevil,** *Pissodes strobi* **(Peck), labelled with radioactive cobalt.**—*Canad. Ent.* **93** no. 1 pp. 78–79, 2 refs. Ottawa, 1961.

In earlier observations in Ontario on adults of *Pissodes strobi* (Peck) labelled with radioactive cobalt (^{60}Co), labels containing about 200–500 μc. did not affect survival over periods of 1–2 months, but caused excessive mortality over longer periods [*cf. R.A.E.*, A **43** 70–71]. In further investigations of the effect of different quantities on survival, labels were prepared from radioactive cobalt nitrate in acetone mixed with a solution of de Kotinsky cement in benzene, which adhered better to the elytra than the mixture previously used. Labels containing up to 250 μc. ^{60}Co did not significantly affect survival during the two months before hibernation when the adults were confined on white pine [*Pinus strobus*] in late August, but larger amounts caused appreciable mortality. In mid-April, however, when

the beetles resumed activity after hibernation, mortality remained negligible only among adults labelled with amounts of about 50 μc.; it was increasingly severe at higher doses and reached 100 per cent. at 280–400 μc. Labels containing 250 μc. are readily detectable with a portable Geiger radiation probe at a distance of 15 ft., and those containing 50 μc. at about 5 ft. [*cf.* **46** 485].

Pielou (D. P.) & Williams (K.). **The effectiveness of residues of insecticides in preventing reinfestation of apple leaves by apple aphid, *Aphis pomi* DeG. I. Diazinon, Trithion and Sevin.**—*Canad. Ent.* **93** no. 2 pp. 93–101, 3 graphs, 17 refs. Ottawa, 1961.

The following is based on the authors' summary. The effectiveness of insecticidal residues in preventing reinfestation of apple foliage by *Aphis pomi* Deg. was examined in British Columbia by spraying aphid-free trees with experimental materials and observing the progress of colonisation from neighbouring sources of infestation. In this way an estimate of true persistent effect was made, unobscured by relative differences in initial kill. On the trees sprayed with diazinon, which had a half-life of 0·5 day on apple leaves, or with Trithion (half-life 1·8 days), colonisation was almost as rapid as on the control plots, but, on trees sprayed with Sevin (half-life 5·5 days), aphids remained at a commercially low level of population for 17 days and were still significantly fewer than on the control plots after 27 days. It was also noted that, for the same concentration of insecticide, the initial deposits of Trithion, determined immediately after drying, were the highest; this appears to be the result of superior formulation, and the value of this material as an aphicide would seem to lie in its effectiveness in giving immediate kill on application.

Perron (J. P.) & Lafrance (J.). **Notes on the life-history of the onion maggot, *Hylemya antiqua* (Meig.) (Diptera: Anthomyiidae) reared in field cages.**—*Canad. Ent.* **93** no. 2 pp. 101–106, 13 refs. Ottawa, 1961.

The following is based largely on the authors' summary. Investigations on the number of generations of *Hylemyia antiqua* (Mg.), the adult life-span, the population increase and the percentage of pupae remaining in diapause per generation were conducted on onion in large field rearing cages in Quebec from 1953 to 1955. The adult life-span and the percentage of pupae that remained in diapause in each generation depended mostly on temperature, being greatest at low temperatures [*cf. R.A.E.*, A **49** 80]. Some pupae remained in diapause in each generation, especially the third, in which the percentage averaged 99·8. High temperature increased egg-laying, favoured larval establishment and shortened the larval period. The highest numbers of eggs were laid by the females from overwintered pupae and the lowest by females of the second generation (means of 57·8 and 24·3, respectively). The greatest increase in population (25-fold) took place within the second generation, which also contributed the greatest number of overwintering pupae.

Pilon (J. G.) & Blais (J. R.). **Weather and outbreaks of the spruce budworm in the Province of Quebec from 1939 to 1956.**—*Canad. Ent.* **93** no. 2 pp. 118–123, 3 figs., 7 refs. Ottawa, 1961.

The following is based almost entirely on the authors' conclusions from a study in which outbreaks of *Choristoncura fumiferana* (Clem.) on balsam fir

(*Abies balsamea*) in Quebec in 1939–56 were related to precipitation and temperature [*cf. R.A.E.*, A **39** 151; **46** 314]. The way in which the outbreaks progressed across the Province supports the theory of climatic release [*cf.* **47** 264, etc.]. Successive early summer droughts undoubtedly caused endemic populations to react and resulted in the progressive appearance of outbreaks from west to east. Moth dispersal in the direction of the prevailing winds [*cf.* **40** 300; **47** 264] must also have been a contributing factor and helps to explain the progress of outbreaks in the two regions where prolonged drought periods did not occur. The two factors, climatic release and adult dispersal, apparently acted concurrently, and their united action was responsible for the rapid progress of the outbreaks across Quebec. No significant relation was found between air temperature and population changes.

Morris (R. F.). **Life-history and habits in Newfoundland of** *Swammerdamia lutarea* **(Haw.) (Lepidoptera: Yponomeutidae), a pest new to North America.**—*Canad. Ent.* **93** no. 2 pp. 130–135, 7 figs., 5 refs. Ottawa, 1961.

The European Hyponomeutid, *Swammerdamia lutarea* (Haw.), all stages of which are briefly described, was recorded for the first time in North America in June 1954, when the larvae severely infested ornamental hawthorns (*Crataegus oxyacantha* and *C. pedicellata*) in St. John's, Newfoundland. Observations on its bionomics were made in 1957–59, and the following is based largely on the author's summary of them. There was only one generation a year. The first-instar larvae overwintered in hibernacula on the twigs and left them to feed on the leaves, which they web together, in early June. Pupation occurred in cocoons on the leaves between 23rd July and 20th August. Adults emerged from 31st July to 4th September, and eggs were laid on the leaves from 10th August to 5th September. The larvae hatched in 12–28 days and mined in the leaves until they moved to the twigs to overwinter. No parasites were reared from over 200 field-collected larvae and pupae. High mortality was caused among hawthorn trees and shrubs, but, owing to their limited value, is not considered of serious economic importance.

Cuming (F. G.). **The distribution, life history, and economic importance of the winter moth,** *Operophtera brumata* **(L.) (Lepidoptera, Geometridae) in Nova Scotia.**—*Canad. Ent.* **93** no. 2 pp. 135–142, 6 figs., 9 refs. Ottawa, 1961.

The following is based almost entirely on the author's summary of this account of field and insectary studies on the bionomics of *Operophtera brumata* (L.), all stages of which are briefly described. This European Geometrid has been present in Canada for at least 30 years [*cf. R.A.E.*, A **44** 226], but is confined to Nova Scotia, where its known distribution gradually extended between 1950 and 1959. Its most important food-plants are apple and, to a less extent, red oak (*Quercus rubra*) [*cf. loc. cit.*]. Its life-history in Nova Scotia [*cf.* **44** 227] is similar to that in western Europe. There is one generation a year, and the winter is passed in the egg stage. Hatching occurs in late April and May. First-instar larvae feed on the opening buds of the food-plant; later instars completely consume the leaves. In late June, the fifth-instar larvae drop to the ground and pupate in the soil. Adults emerge from late October to mid-December. Mating occurs

on the tree trunks, and each female lays about 150 eggs singly or in groups of 2–3, usually in crevices in the bark, under lichens, and in other sheltered sites on the tree [*cf.* **48** 17]. Analyses of plot records for 1952–56 showed that the condition of red oak in young stands and in a stand of mainly pole-sized trees gradually deteriorated, trees dying as a result of repeated defoliation.

Robinson (A. G.). **Some problems associated with weighing aphids that have fed after starving, as a method of measuring intake of plant sap.** —*Canad. Ent.* **93** no. 2 pp. 156–160, 23 refs. Ottawa, 1961.

In a discussion of problems connected with the weighing of aphids for measurement of their intake of plant sap, the author points out that essential requirements are that the test aphids, preferably adult apterae, should be of the same strain [*cf. R.A.E.*, A **45** 352; **47** 376; **48** 297] and of approximately the same age, that environmental conditions should be constant during the starving or feeding periods [*cf.* **27** 323; **48** 374], and that these periods should be long enough to ensure that reproducible data on weight gain are obtained. An account is given of experiments begun in an attempt to establish starvation–feeding test techniques for use in investigations on *Macrosiphum* (*Acyrthosiphon*) *pisum* (Harris) already noticed [**48** 525], and the following is based on the author's summary of the work. Apterous summer viviparae not yet in parturition were weighed individually, starved for 14, 16 or 18 hours, weighed, fed for a period of three or six hours on broad bean (*Vicia faba*), and weighed again. In a further test, females that had begun reproducing were starved for 14 hours and fed for six, 12 or 24 hours. Both tests indicated that feeding periods of up to 24 hours after starving are not sufficient for plant sap ingested by this aphid to be reliably measured. This is probably because the aphids begin excreting honeydew and producing nymphs as soon as they resume feeding.

Ghent (A. W.). **A study of the group-feeding behaviour of larvae of the jack pine sawfly,** *Neodiprion pratti banksianae* **Roh.**—*Behaviour* **16** no. 1–2 pp. 110–148, 2 pls., 8 figs., 14 refs. Leiden, 1960. (With a summary in German.)

The following is based on the author's summary of this account of laboratory observations on the group feeding behaviour of *Neodiprion pratti banksianae* Rohw. on jack pine (*Pinus banksiana*). Preliminary studies showed that hatching orientation was constant, all larvae being directed towards the needle tip [*cf. R.A.E.*, A **47** 449]. Newly hatched larvae of this sawfly have white head capsules and do not orient to light for an hour, by which time pigmentation of the head is well advanced. Egg-bearing needles were not preferred as sites for the first feeding. Aggregations of larvae were too large and frequent to be the result of chance, and were found to be produced independently of light, temperature and humidity. The stimulus to aggregate remained equally strong throughout larval life, although the size of feeding groups diminished with increase in size of the head capsule. In the absence of food, larvae dispersed at random to give a distribution agreeing with the Poisson series, but were found to respond to the odours of pine foliage and of the saliva of other larvae; established feeding sites are thus thought to attract additional larvae.

No difference in the rate of development of larvae reared in groups and solitary larvae was seen, but significantly higher mortality, nearly all of it

in the first instar, occurred in solitary rearing. Feeding aggregations were invariably formed round a feeding site established by a single larva. So long as this larva remained alone, the site was restricted to a small part of the periphery of the needle along its edge; additional larvae took advantage of the existing incision and fed in close contact with the first. Mortality in solitary first-instar larvae was significantly reduced by the provision of an artificial cut in the needle. Once the feeding site was extended beyond the minimum limit accommodating their heads, the larvae ceased to aggregate. The evolutionary significance of group feeding is discussed, and the selective advantage gained in the first instar by group exploitation of the incisions made by the few larvae that succeed in cutting the tough cuticle and epidermis of the needles is considered to be responsible for it.

Smith (B. C.). **A technique for rearing Coccinellid beetles on dry foods, and influence of various pollens on the development of** *Coleomegilla maculata lengi* **Timb. (Coleoptera: Coccinellidae).**—*Canad. J. Zool.* **38** no. 6 pp. 1047–1049, 1 pl., 3 refs. Ottawa, 1960.

In the work described, first- and second-instar larvae of *Ceratomegilla* (*Coleomegilla*) *maculata lengi* (Timb.) were kept individually in cells formed by placing two sheets of plexiglass of equal size, the upper with holes drilled through it, on a sheet of plate glass of similar size in a box and covered by six strips of glass; two small holes were drilled in the lower sheet of plexiglass beneath each of the holes in the upper sheet, to contain food and water. Older larvae and pupae were each kept in the lower half of a petri dish covered with a perforated plexiglass disk and containing a slide with cavities for food and water. The food provided comprised pulverised dried nymphs and adults of *Aphis* (*Rhopalosiphum*) *maidis* Fitch [*cf. R.A.E.*, A **49** 597] or the dried pollen of six different plants, which was sieved and stored in darkness at 4°C. [39·2°F.]. Adults that subsequently laid fertile eggs developed from larvae reared on powdered aphids and on pollen from all the plants except ragweed (*Ambrosia artemisifolia*), which was apparently rejected, and red pine (*Pinus resinosa*), which was eaten but inadequate for growth. Development lasted a mean of about 24 days on diets of aphids and suitable pollens; survival to the adult stage did not differ significantly among larvae reared on aphids or on pollen of grey birch (*Betula populifolia*) or hornbeam (*Carpinus caroliniana*), but was significantly lower among those reared on pollen of maize or hemp (*Cannabis sativa*). Provided that a dry food is nutritionally adequate, the chief requirement for growth is that the particles should be small enough to be ingested by first-instar larvae.

Juillet (J. A.). **Some factors influencing the flight activity of Hymenopterous parasites.**—*Canad. J. Zool.* **38** no. 6 pp. 1057–1061, 2 graphs, 1 ref. Ottawa, 1960.

The following is partly based on the author's abstract. The average captures of diurnal Hymenopterous parasites in rotary traps [*cf. R.A.E.*, A **49** 328] operated in a plantation of red pine (*Pinus resinosa*) in a reforestation area in Ontario during the summer of 1959 were analysed in relation to weather elements. The results showed that in general Ichneumonids were most active at average temperatures (70–75°F.), high relative humidity (80–100 per cent.) and low wind velocity, Braconids at higher temperatures (70–80°F.), low relative humidities (20–40 per cent.) and low wind velocity,

and Chalcidoids, which were unaffected by wind velocities, at the highest temperature (85°F.) and lowest relative humidity (20 per cent.). These findings are related to the types of vegetation in which the parasites are most active.

Burnett (T.). **Effects of initial densities and periods of infestation on the growth-forms of a host and parasite population.**—*Canad. J. Zool.* **38** no. 6 pp. 1063–1077, 8 graphs, 1 ref. Ottawa, 1960.

The following is partly based on the author's conclusions. Since earlier experiments had indicated that variations in the growth forms of populations of *Trialeurodes vaporariorum* (Westw.) and its parasite, *Encarsia formosa* Gah., propagated on tomato in the greenhouse, were related to the initial densities of the host and parasite and the age-structure of the population [*cf. R.A.E.*, A **49** 484], the influence of these factors was further investigated in experiments with eight populations reared under similar conditions over periods of eight months in two successive years. The four reared during the first year differed in the initial numbers of hosts and parasites and those in the second in the period over which hosts and parasites were liberated on the plants. Numbers of hosts and parasites again fluctuated with peaks of increasing magnitude during the early stages of each population [*cf. loc. cit.*]. Provided that the periods over which introductions were made were identical, the magnitude of the fluctuations increased with initial densities of host and parasite. In populations with similar initial host and parasite densities, fluctuations began late and were relatively small where the host was introduced over a long period (32–33 days) and were relatively great where it was introduced over a short one (15–16 days); the parasites reached peaks equalling or exceeding those of the host where they were introduced over long periods and considerably lower ones where their introduction period was short; the highest and lowest average densities and fluctuations occurred where the period of parasite introduction was long; and the second of the first two consecutive fluctuations in the host population equalled the first where both host and parasite were introduced over either long or short periods, and exceeded it where the introduction periods of host and parasite differed. Since the growth forms of the populations varied markedly, it is necessary, in analysing the interaction of the two species, that the initial densities should be controlled.

Pielou (D. P.). **The effect of DDT on oviposition, and on behavior, in the European red mite, *Panonychus ulmi* (Koch).**—*Canad. J. Zool.* **38** no. 6 pp. 1147–1151, 12 refs. Ottawa, 1960.

The following is based mainly on the author's abstract of this account of an attempt to confirm in the laboratory the suggestion that DDT induces increased egg-production in *Panonychus ulmi* (Koch) [*cf. R.A.E.*, A **43** 341; **45** 336; **48** 547]. Newly emerged females of a strain from the Okanagan Valley, British Columbia, were allowed to oviposit individually on single whole isolated apple leaves for their entire life. On leaves sprayed with DDT and bearing mean deposits of 3·1 and 10·6 μg. per sq. cm., which approximate the range from sprays applied in orchards with effective concentrate spraying equipment at recommended rates, the total egg-production per female, the adult survival period and the daily rate of oviposition were not significantly different from those on unsprayed leaves. Females were also placed on isolated leaves, one half of each of which had

been sprayed with DDT. They subsequently spent 3·4 times as much time on the unsprayed halves as on the sprayed halves and laid 5·6 times more eggs on them. *P. ulmi* is therefore thought to be irritated and repelled by DDT [*cf.* also **41** 203].

Yoshida (T.). **Local distribution of the eggs of the pea weevil,** *Bruchus pisorum* **L.** [*In Japanese.*]—*Mem. Fac. liberal Arts Miyazaki Univ.* Nat. Sci. **6** pp. 11–21, 6 figs., 12 refs. Miyazaki, 1959. (With a summary in English.)

The density of the eggs of *Bruchus pisorum* (L.) on pea plants was estimated in five gardens at each of seven villages in the Miyazaki area of Kyushu on 1st–5th May 1955. The numbers of eggs per stem indicated aggregative distribution. Where the density was high, the number of eggs per stem was positively correlated with the number of pods per stem. The numbers per stem varied between the five gardens in each village; the villages could be divided into four classes based on the numbers of eggs per pod, which were lowest in the open fields, higher in larger villages and villages closer to the mountains, and highest in an isolated mountain village. It is considered that the population of the Bruchid is divided into isolated village breeding units.

Yoshida (T.) & Kawano (K.). **Seasonal fluctuation of the number of insects in the grains stored at farm-house. 1.** [*In Japanese.*]—*Mem. Fac. liberal Arts Miyazaki Univ.* Nat. Sci. **5** pp. 11–23, 8 graphs, 19 refs. Miyazaki, 1958. **Fauna and community structure of the insects in the grain stored at farm-houses.** [*In Japanese.*]—*Op. cit.* **7** pp. 33–61, 1 pl., 9 figs., 2 fldg tables, 37 refs. 1959. (With summaries in English.)

In these two papers, the authors describe investigations made in 1955–56 on the insects and other arthropods infesting wheat and barley stored on farms in the Miyazaki and Kushima districts of Kyushu. In the first, observations are recorded on the seasonal trends in the species of insects emerging from grain stored in straw sacks, as determined by examination of grain samples removed every three weeks. *Sitophilus oryzae* (L.) and *S. sasakii* (Tak.) were by far the most numerous; three other species of Coleoptera, three of Lepidoptera, and four species of Pteromalid parasites were also present. Maximum emergence of *S. oryzae* occurred in late July or early August, after which it ceased, possibly owing to parasitism. *S. sasakii* began to emerge in August and continued to do so through the winter, with maximum numbers in September–November. Infestation was greatly reduced by drying the grain in the sun in midsummer. Parasitism averaged 50 per cent.; the level was proportional to the density of the hosts.

The second paper includes an extended list of the arthropods found in the grain near Miyazaki; the 28 insects included the Trogositid, *Lophocateres pusillus* (Klug) which has not previously been recorded from Japan. The community structure of the fauna was investigated in six suburban areas by examination of samples during September–November. *Oryzaephilus surinamensis* (L.) was commoner in wheat than in barley; the other insects showed no differences in infestation of the two grains. The level of total infestation remained the same over the period, but *S. oryzae* declined in numbers and *Plodia interpunctella* (Hb.) increased. In both grains, 90 per cent. or more of the samples contained *O. surinamensis*, *S. oryzae* and *S. sasakii*, and *Cryptolestes pusillus* (Schönh.) (*Laemophloeus minutus* (Ol.)),

P. interpunctella, *Tenebroides mauritanicus* (L.), *Carpophilus piloscllus* Motsch., Pteromalid parasites and unidentified Liposcelids were also present in 50 per cent. The relations between the three primary pests, *S. oryzae*, *S. sasakii* and *P. interpunctella*, the secondary pests, *O. surinamensis* and *Cryptolestes pusillus*, and the parasites are considered; since the rate of parasitism was constant at all densities of the host species, the relation was considered to be density-independent. There were increases in the relative numbers of *S. sasakii* and *C. pusillus* with passage of time, associated with increase in infestation density. There was a significant positive correlation between the densities of *O. surinamensis* and *C. pusillus*, but none between those of *S. oryzae* and *S. sasakii* or between those of the primary and secondary pests.

Tamura (I.), Iwata (T.) & Kishino (K.). **Geographical races in the rice stem maggot, *Chlorops oryzae* Matsumura.** [*In Japanese.*]—*Jap. J. appl. Ent. Zool.* **3** no. 4 pp. 243–249, 2 figs., 15 refs. Tokyo, 1959. (With a summary in English.)

Chlorops oryzae Mats., an important pest of rice, passes through two generations annually in the north and three in the south of Japan, with local variations in the time of emergence of the adults [*cf. R.A.E.*, A **49** 495, etc.]. Studies were made at Takada on the growth and development of larvae sent in samples of their winter food-plants [*cf.* **39** 300] from northern, southern and intermediate districts and from a mountainous southern district, and larvae locally collected. The slowest growth and latest emergence of adults, with larval and pupal periods of 50 and 11–12 days, respectively, were seen in larvae from Omagari, in the north. Those from Takada developed the most rapidly and gave rise to the earliest adults, with larval and pupal periods of under 30 and 10 days, respectively; those from Hatano, in the south, took slightly longer. Larvae from the border districts and the mountainous district were intermediate in development, with variations in the duration of the larval stage from less than 20 to 50 days.

It is concluded that there are two races of the Chloropid, a northern one with two generations a year and a southern one with three, with a variable population in intermediate areas, which probably support a hybrid population. Evidence of hybridisation was obtained when females from Takada were crossed with males from Omagari. The offspring showed variable duration of the larval stage, resembling the populations of the intermediate areas.

Tsuji (H.). **Studies on the diapause of the Indian-meal moth, *Plodia interpunctella* Hübner. III. The influence of high temperature on the inception of diapause in the 20° C. non-diapause stock.** [*In Japanese.*] —*Jap. J. appl. Ent. Zool.* **3** no. 4 pp. 250–254, 5 graphs, 5 refs. Tokyo, 1959. (With a summary in English.)

This paper is one of a series on the factors influencing the diapause of the larva of *Plodia interpunctella* (Hb.) [*cf. R.A.E.*, A **47** 451; **49** 388]. Normal larvae of the Pyralid reared at 20°C. [68°F.] all enter diapause, but a stock was developed by selection for early adult emergence that did not enter diapause when reared continuously at that temperature. In this stock, exposure to 30°C. [86°F.] for 2–8 or 12 days between the egg stage and the second larval instar induced diapause. After termination of the diapause, the larvae pupated normally, and the offspring of the resulting adults did not enter diapause when maintained at 20°C.

Fukami (J.), Nakatsugawa (T.) & Narahashi (T.). **The relation between chemical structure and toxicity in rotenone derivatives.**—*Jap. J. appl. Ent. Zool.* **3** no. 4 pp. 259–265, 3 figs., 17 refs. Tokyo, 1959. (With a summary in Japanese.)

The results are reported of a study in which rotenone and 34 derivatives of it were compared for their insecticidal action on *Callosobruchus chinensis* (L.), their inhibition of l-glutamic dehydrogenase in the mitochondrial fraction of the thoracic muscles of *Xylotrupes dichotomus* (L.), and the times taken to block conduction in preparations of the isolated abdominal nerve-cord of *Periplaneta americana* (L.). The insecticidal effects were estimated from the mortality in batches of adult males of *C. chinensis* after 48 hours of exposure to the residues left in petri dishes by evaporation of acetone solutions of the compounds. Of the 34 derivatives, only seven showed toxicity to the beetles, and the only one to approach rotenone in effectiveness was dihydro-rotenone.

With some exceptions, there was a close correlation between the values for the three forms of biological activity in each compound, and the relation between them and the molecular structure of the compounds is discussed. The results showed that biological activity is associated not only with the chromano-chromanone ring, but also with the chromano-chromanol ring. Trans-configuration of asymmetric carbon atoms at position 7 and 8, as in rotenolone-I, was associated with higher toxicity than the cis-configuration. Rotenone hydrochloride, though showing enzymic and nervous toxicity, was insecticidally inactive, possibly owing to inability to penetrate the cuticle or to detoxification before reaching the site of action.

Yoshida (T.) & Takuma (T.). **Seasonal fluctuation of the number of the flower-visiting rice weevil, *Sitophilus oryzae* Linné.**—*Jap. J. appl. Ent. Zool.* **3** no. 4 pp. 281–285, 1 graph, 7 refs. Tokyo, 1959. (With a summary in Japanese.)

Observations at Miyazaki, in southern Kyushu, on the flower-visiting habits of *Sitophilus oryzae* (L.) are reported. Five species of flowers were inspected at intervals of five days, and a census of the weevils made, after which they were returned to the plants. Weevils were found from mid-April to the end of May, the maximum numbers occurring in the first week of May, and they were most attracted to flowers producing nectar. As earlier work had shown that *S. oryzae* is longer-lived and more prolific on a diet of nectar, the habit is of economic importance; it also differentiates *S. oryzae* from *S. sasakii* (Tak.) [*cf. R.A.E.*, A **46** 209].

Tamaki (Y.). **Studies on nutrition and metabolism of the smaller tea tortrix, *Adoxophyes orana* (Fischer von Röslerstamm). I. Aseptic rearing of the larvae on synthetic diets.**—*Jap. J. appl. Ent. Zool.* **3** no. 4 pp. 286–290, 1 graph, 7 refs. Tokyo, 1959. (With a summary in Japanese.)

As a preliminary to studies on the nutrition and metabolism of *Adoxophyes orana* (Fisch. v. Roesl.), which is an important pest of tea in Japan, a technique for rearing the larvae on an aseptic, chemically defined medium was evolved. A basic diet containing agar, cellulose, glucose, casein, cholesterol and Wesson's salts was supplemented with 25·4 per cent. by weight of dry yeast, powdered tea leaf, or mixtures of the two in different proportions, and the effects on growth and survival of the larvae, on pupation, and on emergence of the adults were compared. It was found that, although

diets with a high proportion of yeast promoted larval growth and survival, further development was dependent on factors contained in the leaf powder, 10 per cent. or more of which was essential to an optimum diet.

MASAKI (J.). **Studies on rice crane fly, (*Tipula aino* Alexander, Tipulidae, Diptera) with special reference to the ecology and its protection.** [*In Japanese.*]—*J. Kanto-Tosan agric. Exp. Sta.* no. 13, [2 +] 195 pp., 6 pls., 48 figs., 176 refs. Konosu, Saitama, 1959. (With a summary in English.)

A detailed account is given of studies on the bionomics and ecology of *Tipula aino* Alex., which occurs throughout Japan, except for Hokkaido, and has two generations annually, overwintering in the larval stage. In both generations, emergence of the adults occurs at temperatures of 5–30°C. [41–86°F.] and is at a maximum when the water content of the soil is 60–70 per cent.; there was no emergence from pupae buried only 2 cm. deep by cultivation. The females are active and are more readily attracted than the males to light-traps, which are most effective when of the rotatory type.

Oviposition occurs in April–May and September–October [*cf. R.A.E.*, A **24** 697], after a preoviposition period averaging 3–4 days [*cf.* **25** 477]. Eggs are laid in soil with moisture contents between 54 and 99 per cent., at a depth of 1·5 mm.; the number per female averages 418 in the overwintered and 278 in the first generation. This difference is correlated with the shorter life-span of the latter. The eggs do not hatch in soil of water content below 20 per cent.; flooding is also unfavourable. The limits of temperature for hatching are 10–30°C. [50–86°F.]; the upper limit may be encountered by eggs laid in autumn.

The larvae reach maximum size in 80 days in the first and 95 in the second generation, which represents about half the total larval period. They are killed by temperatures above 45°C. [113°F.] and below −10°C. [14°F.], the optimum temperature for larval growth being about 20°C. [68°F.]. The optimum water content of the soil is 70 per cent.; loams are more suitable than sandy or clay soils. Larvae move away from dry areas, and from farm-yard manure or night-soil, but are attracted by plant residues. The usual depth of the larvae is 1–2 cm., but hibernating individuals bury themselves to depths of 5 cm. Hibernation lasts 100 days, with complete dormancy at soil temperatures below 7°C. [45°F.]. The optimum water content of the soil for survival at this stage is about 85 per cent.

The overwintered larvae pupate in April–May, and those of the first generation in August–October, the duration of the pupal stage averaging 5–6 days. The specific gravity of the pupae is higher in spring than in autumn, those with a value of 1 or more averaging 27 per cent. of males and 19 per cent. of females in the former season, and 5 and 4 per cent. in the latter, respectively. This has a bearing on survival, since submerged pupae die, and spring flooding reduces their numbers.

The seeds and seedlings of rice, wheat, barley and rye are severely damaged, though certain varieties of rice are relatively resistant. The time of sowing of wheat and barley and of transplanting rice has a marked effect on the degree of damage, the heaviest attacks being on crops sown in April and early November in the Kanto district. Drainage and biological control by ducks may reduce populations, as also may soil cultivation at the time of adult emergence. Wheat and barley can be protected by dry seed dressings containing DDT, endrin, aldrin or dieldrin at 5, 2, 4 and 4 per cent., respectively, applied to the seed at 0·02 per cent. by weight. The same

dusts can also be applied to the seed drill at 18–27 lb. per acre. Parathion and BHC are effective when applied in emulsions to wet fields and as dusts to dry ones.

YAMAZAKI (S.) & HATAI (N.). **Studies on the behaviour of rice stem borer in regard to some factors concerning insecticidal experiments.** [*In Japanese.*]—*Bull. nat. Inst. agric. Sci.* (C) no. 11 pp. 1–36, 7 graphs, 12 refs. Tokyo, 1960. (With a summary in English.)

To increase the accuracy obtainable in tests of insecticides for the control of *Chilo suppressalis* (Wlk.) on rice in Japan, studies were made of the behaviour of the larvae hatching from egg-masses removed from cold storage and attached to the leaves of plants grown in pots. The larvae from an egg-mass so placed move in a group and bore into the stem, the number and percentage doing so being positively correlated with the number of larvae hatching. They spread to other stems of the same plant, but very little to other plants. The variance of the percentage of larvae that enter is reduced by taking the plant rather than the stem as a unit, and by placing three egg-masses, each producing 60–90 larvae, on separate leaves. For the first six days after hatching, most of the young larvae that hatch on leaf-sheaths remain in the third leaf-sheath from the outside. By the 10th day, most of them reach the culm by boring through the node; this takes place sooner, and mortality is less, if many are present. Mortality is also less on plants producing many ears than on those with heavy ears. Larvae of the second generation take longer to bore into the stem than those of the first, and their mortality is subsequently lower.

In tests of insecticides, the period before dispersion of the larvae, from the 2nd to the 6th day in the first generation, is critical, and the ratio of larvae surviving to those hatching is more important than the mortality.

ITÔ (Y.). **Ecological studies on population increase and habitat segregation among barley aphids.**—*Bull. nat. Inst. agric. Sci.* (C) no. 11 pp. 45–130, 33 figs., 5½ pp. refs. Tokyo, 1960. (With a summary in Japanese.)

Field and laboratory observations are recorded on factors affecting the development of populations of three species of aphids that infest barley in Japan, *Aphis maidis* Fitch, *Macrosiphum avenae* (F.) and an apple-grain aphid of the genus *Rhopalosiphum* referred to as *R. prunifoliae* (Fitch) [but *cf. R.A.E.*, A **49** 563]. In the field, *A. maidis* was found on the upper leaf blades, *M. avenae* on the basal blades and *Rhopalosiphum* on the middle blades and the stems of barley. When single apterous viviparae were placed on barley plants in pots, each species settled in its favoured habitat and reproduced until crowding occurred, after which part of the population moved to other blades and the whole plant was eventually infested. At saturation point, emigration from the plant occurred, and equilibrium was maintained by this means rather than by increased mortality or decreased fecundity. In each species, the growth of the population on a leaf or on a whole plant followed a logistic curve, the saturation densities, in individuals per 10 sq. cm. of leaf, being 100, 110 and 130 for the three species, respectively. When two or more species were reared together, each first overcrowded its own niche and then spread over the plant. The joint populations so formed continued to co-exist, relieved by migration, but this took place at lower levels of density than when the species were reared singly. When migrating individuals from a mixed population reached a new plant, their preferences

for specific micro-habitats were again evident, and they were also demonstrated by transferring aphids on paper platforms to different levels on new plants, when they invariably moved to the preferred level.

M. avenae and *Rhopalosiphum* are common on wheat in the field, and experiments showed that they preferred wheat seedlings to barley seedlings, but *A. maidis*, which is uncommon on wheat, showed no preference, and its rate of reproduction was greater on barley than on wheat. In cage tests with middle leaf blades, *A. maidis* and *Rhopalosiphum* preferred barley to wheat, and appeared to be more fertile on it, while *M. avenae* preferred wheat to barley. *A. maidis* produced more young on an upper blade than on a middle blade, and survived to maturity better on barley than on wheat, but appeared to produce about the same number of young. On wheat plants in pots, *A. maidis* did not increase its numbers in mixed populations to the same extent as the other two, but usually survived. When barley and wheat were grown together, *A. maidis* increased in numbers on the wheat and decreased on the barley; with the other two species, the reverse occurred.

These results stress the effect of ecological factors such as population density on the food-plant relations of the aphids. The scarcity of *A. maidis* on wheat in the field is considered to be caused by its higher rate of mortality on wheat than on barley, the preference for barley shown by both alatae and apterae, the absence of protective curled blades such as occur on barley, and the mass effect of field crops in enabling aphids to find their food-plants. Surveys of the occurrence of the three species on other graminaceous plants and sedges are briefly reported.

Smith (B. D.). **The behaviour of the black currant gall mite** (*Phytoptus ribis* **Nal.**) **during the free living phase of its life cycle.**—*Rep. agric. hort. Res. Sta. Bristol 1959* pp. 130–136, 3 graphs, 5 refs. Long Ashton [1960].

The following is substantially the author's summary. In field and laboratory studies in south-western Britain on the behaviour of *Cecidophyes* (*Phytoptus*) *ribis* (Westw.) on black currant, it was found that temperature controls the rate at which the mites emerge from infested buds in spring and their subsequent rate of movement; it also determines the main migration period, which does not appear to be closely correlated with a particular growth stage of the plant. The mites are very sensitive to desiccation, and leave drying buds sooner than others. They spread within a bush, or to bushes at varying distances from the source of infestation, by crawling towards the light, by leaping with the aid of the wind, and by transport by rain or on the bodies of insects, especially aphids and small Diptera. The method by which they enter newly formed buds is described.

Smith (B. D.). **Effects of temperature and photoperiod on black currants and on the behaviour of the gall mite** (*Phytoptus ribis* **Nal.**).—*Rep. agric. hort. Res. Sta. Bristol 1959* pp. 137–138, 3 refs. Long Ashton [1960].

The following is substantially the author's summary. The behaviour of *Cecidophyes* (*Phytoptus*) *ribis* (Westw.) was studied in south-western Britain on black currants in which dormancy had been broken, or prevented from occurring, by changes in temperature and day-length. The overwintering phase of the life-cycle appears to include a true diapause during dormancy of the food-plant, and the timing of it is regulated by the plant. The time interval before egg-laying begins in newly invaded axillary buds appears to depend on the physiology of the plant.

Hollings (M.). **Aphid movement and virus spread in seed potato areas of England and Wales. Assessment of areas by measured aphid movement.**—*Plant Path.* **9** no. 1 pp. 1–7, 2 figs., 4 refs. London, 1960.

The following is substantially the author's summary. Methods for assessing aphid movement in relation to virus spread were applied on a wide scale in 1955–57 in the areas of England and Wales in which seed potatoes are produced. There was a significant positive correlation between the angle of colonisation [*R.A.E.*, A **48** 98] of *Myzus persicae* (Sulz.) and the spread of leaf roll in crops, although the regression of leaf-roll spread on angle of colonisation differed considerably from year to year. Only 12 per cent. of the crops with angles of colonisation less than 55° showed virus breakdown (more than a five-fold increase in leaf roll), as compared with 31 per cent. of those with angles of 55–59° and 47 per cent. of those with angles greater than 59°.

Hughes (R. D.). **A method of estimating the numbers of cabbage root fly pupae in the soil.**—*Plant Path.* **9** no. 1 pp. 15–17, 1 fig., 2 refs. London, 1960.

The following is almost entirely the author's summary. A simplified method of estimating the numbers of pupae of *Hylemyia* (*Erioischia*) *brassicae* (Bch.) in the soil round cruciferous-vegetable plants was developed in central England. It consists of taking small samples of soil at known distances from the plant stem and removing the pupae by sieving or flotation in water. On areas of up to half an acre, samples from round 30 plants give a good estimate of the pupal population. On larger areas, more samples would be required to give estimates of comparable accuracy.

Thomas (P. R.). **Control of swede midge on savoys.**—*Plant Path.* **9** no. 1 pp. 25–28, 1 pl., 1 graph, 4 refs. London, 1960.

Investigations on the value of insecticides in controlling *Contarinia nasturtii* (Kieff.) on savoy cabbage in south-western England [*cf. R.A.E.*, A **35** 208] were carried out in 1956–58. An economic method of obtaining complete control of the Cecidomyiid seems impracticable on a slowly maturing crop of low value such as savoys. Partial control was given by a spray of 0·1 per cent. dieldrin applied weekly at 200 gal. per acre to the seedbed and dipping the plants in 0·05 per cent. dieldrin before planting out. A malathion dust and spray were less effective.

Jepson (W. F.) & Southwood (T. R. E.). **The recognition of the immature stages of *Elachiptera cornuta* (Fallén) (Diptera: Chloropidae), with notes on its association with *Oscinella frit* (L.) in oatfields.**—*Proc. R. ent. Soc. Lond.* (A) **35** pt. 1–3 pp. 24–29, 3 figs., 8 refs. London, 1960. **The spring oviposition peaks of frit fly and associated Diptera in young oats.**—*Plant Path.* **9** no. 1 pp. 33–35, 1 graph, 4 refs. London, 1960.

In the first paper, the authors state that the numbers of eggs found in soil samples taken from fields of oats in southern England during population studies on *Oscinella frit* (L.) showed increases during the second and third weeks of June, when oviposition by *O. frit* is usually decreasing. This was due to the presence of the very similar eggs of *Elachiptera cornuta* (Fall.),

a Chloropid that is generally regarded as a secondary pest of oats [*cf. R.A.E.*, A **30** 405], but has been recorded feeding in plants not already infested by *O. frit* [**25** 523]. As an aid to the prevention of overestimates of the immature stages of *O. frit*, characters are given for the separation of the eggs and three larval instars of the two species. Adults of *E. cornuta* were always scarce over spring oats early in the season, and the many eggs present in mid-June are probably laid by females entering the fields from the grass headlands. In 1958, the adults reached peak numbers on 3rd July and those of a further generation were present on 28th August, when the panicle generation of *O. frit* was at a peak. Females of this generation of *E. cornuta* are thought to lay their eggs under fallen plants and even beneath bark. Any sudden increase in numbers of eggs after 5th or 6th June in a normal year, following a peak in numbers of adults of *O. frit* about 25th May, may be attributable to *E. cornuta*, and many of the larvae in infested shoots of spring oats after the first week in June may be referable to this species.

In the second paper, the authors state that, in the locality concerned, oviposition by *O. frit* continues from mid-May until the second week in June. In 1958 and 1959, eggs of *E. cornuta* were first found on 9th and 3rd June, respectively, and soon became numerous, whereas those of *O. frit* became scarce. Eggs of *Hydrellia* sp., which are readily distinguished from those of *O. frit* by microscopic characters, were present from 1st to 14th June, and *Hydrellia* larvae were often found when soil and débris were washed from the base of oat plants infested by *O. frit*. Adults of five other Chloropids, the eggs of which can probably not at present be distinguished from those of *O. frit*, were also found, mostly when the main oviposition period of *O. frit* was over, but they were sufficiently scarce to be of negligible importance.

Balfour-Browne (F. L.). **The green muscardine disease of insects, with special reference to an epidemic in a swarm of locusts in Eritrea.**— *Proc. R. ent. Soc. Lond.* (A) **35** pt. 4–6 pp. 65–74, 63 refs. London, 1960.

Many locusts in a mature swarm of *Schistocerca gregaria* (Forsk.) that settled in north-eastern Eritrea on 20th February 1959 were observed to be dead or dying five days later. They were found to be affected by a fungus, subsequently identified as *Metarrhizium anisopliae*, which evidently largely destroyed the swarm, since many dead locusts were found where it last roosted before leaving the area on 27th February and only a few scattered locusts were observed to leave. In view of the wide range of insects attacked by *M. anisopliae*, which are listed, and the many attempts that have been made to use it in biological control, the author reviews from the literature the various methods that have been adopted to introduce the fungus, which she describes, into test insects, the relation between successful infestation and weather conditions, notably moisture, and methods for preventing it from attacking beneficial insects; she also lists some insects that have been artificially infested and discusses the value of the fungus in control. It is concluded that, although it can effectively control insects in a confined space or small area, epizootics develop only occasionally and under particular natural circumstances, and the possibility of producing them artificially in large insect populations is remote. In addition to the risk of destroying beneficial species with the noxious ones and the difficulties imposed by uncertainties of weather, insect biology and fungus virulence, problems are presented by the large-scale production and storage of the spore powder.

Kay (D.). **Termites attacking living tissues of** *Theobroma cacao* **L. in Nigeria.**—*Proc. R. ent. Soc. Lond.* (A) **35** pt. 4–6 p. 90, 2 refs. London, 1960.

Neotermes aburiensis Sjöst. was found in Western Nigeria in the dead and adjoining living wood of cacao trees attacked by *Calonectria rigidiuscula*, a fungus that causes die-back [*cf. R.A.E.*, A **49** 253]. The termite damage, even where extensive, did not kill the trees, but it was thought that the termites might spread the fungus, since their galleries passed through the area between the dead and living wood where it was active. However, *C. rigidiuscula* did not develop when living wood from the sides of the galleries was cultured, and it is therefore unlikely that the termites spread it. *Coptotermes* sp. and *Microtermes* sp. were also found in dead branches, but they did not attack living wood. Seedlings, young trees and basal chupons in many parts of Western Nigeria were ring-barked by *Macrotermes nigeriensis* (Sjöst.). The damage usually extended from soil level to a height of 2 ft., but sometimes occurred 16 ft. above soil level. It first became apparent at the beginning of the rains, was prevalent where coppiced trees had been earthed up, litter had accumulated close to the trunks, or trees had been mulched, and frequently killed chupons and seedlings and sometimes young trees. Where termite control is desirable, the removal of dead branches is recommended to prevent infestation by *N. aburiensis* and to control *Coptotermes* and *Microtermes*; nests of *Macrotermes nigeriensis* near cacao trees should be destroyed and, if infestation is heavy, a soil insecticide applied.

Report of the West African Timber Borer Research Unit, 1958–59.—43 pp., frontis., 1 pl., 7 figs. London, 1960.

The following is based on the general summary of this third report [*cf. R.A.E.*, A **47** 397], which covers the years 1958–59. During this period, investigations were begun on the bionomics and ecology of ambrosia beetles (Scolytids and Platypodids) in Nigeria. Collections were made in southern Nigeria and the British Cameroons, and susceptibility tests were begun with 32 timber species of economic importance at three localities. The results were similar to those obtained in Ghana [*loc. cit.*], and only one species (*Antiaris africana*) proved less attractive to the beetles than had been expected. The level of attack in the different localities seemed to be related in some way with rainfall, reaching its maximum in the wettest one.

Much time was devoted to study of *Trachyostus ghanaensis* Schedl [*cf.* **49** 211], a Platypodid that is confined to living trees of *Triplochiton scleroxylon*. The galleries made by it penetrate radially into the tree and divide near the heart into two concentric branches, from which further branches, usually vertical, are given off. The galleries are lined with fungus, on which the adults and larvae feed, and development from egg to adult probably lasts about two months. Attack begins when the trees are about 2–3 ft. in girth, and reaches its maximum at about 5–7 ft. girth. The beetle does not occur east of the river Volta, and is present in Ghana and the Ivory Coast and probably also in parts of Liberia and Guinea. Its absence to the east is probably due to almost complete lack of its host-tree in the 'Dahomey Gap' between Ghana and Nigeria and the low moisture régime of the area. Where it occurs, it is most abundant in thick, high forest, and scarce where farming operations have created more open conditions. The down-grading of infested timber is mostly due to staining, and the possibilities of chemical control are poor. The Platypodid that bores in *Terminalia*

superba was identified as *Doliopygus dubius* (Samps.); it attacks felled trees of various species in Ghana and Nigeria.

In a preliminary test on the use of insecticides to protect floating logs against ambrosia beetles, a paint formulation of γ BHC gave 96 per cent. protection of logs of *Triplochiton scleroxylon* for 12 weeks and was superior to grease formulations. An aldrin grease was next best, and malathion gave negligible protection.

Investigations were also begun on the powder-post beetles of Nigeria, and the species of importance and the timbers most susceptible to attack were ascertained; damage to stacked lumber is severe in southern Nigeria. The starch content of the trees is important in relation to attack, and that of *T. scleroxylon* was found in Ghana to fall in May, before the appearance of new leaves, and probably again in November–December. There was great variation in the time taken for the starch to disappear from the sapwood of felled trees, there being sometimes little fall in nine months. Debarked logs exposed to the weather were first attacked by powder-post beetles after eight months, when the moisture content of the wood, based on initial weight, was reduced to 8 per cent. By this time, starch occurred only in patches over the surface of the logs and attack was consequently low.

Limited studies of pests of growing trees showed that opepe (*Nauclea diderrichii*) is attacked by *Hecphora testator* (F.) in Nigeria. Attack begins when the trees are about two years old, and the larvae kill the trees by ringing the bark.

GALICHET (P. F.). **La protection du poisson sec contre le dermeste, *Dermestes maculatus* de Geer dans le bassin tchadien.**—*C. R. Acad. Agric. Fr.* **46** no. 7 pp. 404–410, 6 refs. Paris, 1960.

An account is given of experiments carried out in the Cameroun Republic for the prevention and control of infestation of stored dried fish by *Dermestes maculatus* Deg. In the first, on control, fish and insects in baskets and paper bags were fumigated with methyl bromide at 8·5 oz. per 100 cu. ft., at temperatures ranging from 29·5 to 41·5°C. [85·1 to 106·7°F.], for 6–23 hours. Mortality was complete in every test except one in which fish and insects in a pinned paper bag were fumigated for 12 hours at the lowest temperature, in which some larvae survived, and in the only test in which pupae were used, when all these survived exposure for six hours at 38·5°C. [101·3°F.]. In tests on control by heat, adults of *D. maculatus* died after exposure for 14 minutes to 47°C. [116·6°F.], and adults and larvae after 2 and 2½ minutes at 52°C. [125·6°F.]. In later tests in an earth oven, in which the insects were heated in closed paper bags with fish or in glass jars for six hours, temperatures between 60 and 80°C. [140 and 176°F.] gave complete mortality of eggs and larvae, and exposure to 50–60°C. [122–140°F.] killed all the eggs, but none of the larvae or adults; the temperatures reached within the containers are not known. After either fumigation or heat treatment, the appearance and taste of the fish remained normal. When the fish were exposed to the sun, it was found that those placed horizontally on racks were subjected to a temperature of 53·2°C. [127·76°F.], but those hung upright on poles to only 39·3°C. [102·74°F.]; only the first temperature was sufficiently high to control infestation.

In tests on the prevention of infestation, filter papers soaked in dilutions of a material containing 6 per cent. pyrethrins and 60 per cent. piperonyl butoxide and then dried for six hours were placed on the bottom of glass jars into which larvae of *D. maculatus* were introduced. Similar tests were carried out with wettable BHC and larvae or adults. With the first, at a

concentration of 0·4 per cent. pyrethrins, complete kill or paralysis was effected in 36 hours. With BHC, all the larvae were dead or paralysed in 12 hours at 0·6 per cent., and all the larvae and adults in 36 hours at 0·3 per cent.

The final test was carried out with sacks soaked in 6 lb. BHC per 100 gal. and dried for 24 hours, 50 larvae being put, with fish, into each sack. After three days, no living larvae were found in one sack and only one in the other, but 29 and 14 had apparently disappeared.

Necrobia rufipes (Deg.), which also infests dried fish, was included in some of the tests and appeared to be about as susceptible to the various measures as *D. maculatus*.

Bullock (J. A.). *Nematocerus* **sp. (nr.** *brevicornis* **Hust.)—a pest of cereals in Kenya. I—The bionomics and control of the adult and larva.**—*E. Afr. agric. For. J.* **27** no. 1 pp. 24–32, 6 figs., 1 map, 4 refs. Nairobi, 1961.

An account is given of investigations in 1956–60 on the bionomics and control of an unidentified species of *Nematocerus*, close to or conspecific with *N. brevicornis* (Hust.), that attacks maize, wheat and barley on light soils throughout the Rift Valley Province of Kenya. The eggs of this weevil were laid in batches, averaging 19–21 and ranging up to 54, on vegetation, usually leaves of graminaceous plants, and were sealed by a secretion into a transversely folded leaf. The larvae hatched in 12–15 days, cut round exit holes in the leaf, and burrowed into the soil, reaching depths of 3 ft. or more in the dry season; they fed on roots, seeds and débris. Pupation occurred in the top two inches of soil, and the adults emerged after two weeks; the latter survived for up to seven weeks in the insectary, but for a shorter time in the field. The preoviposition period lasted at least a week. The adults, which are active at night and in dull weather, defoliate the plants by eating irregular pieces from the edges and sometimes also sever young stems. They and the larvae are described.

Several natural enemies were observed, including a Chalcidoid larva that hatched from an egg laid in the sealed pocket and attacked the eggs of *Nematocerus*. Occasionally, two such larvae of different ages were present. Distribution of the Chalcidoid was irregular, but over 35 per cent. of the egg-masses were attacked in one series examined. Its egg, larval and pupal stages lasted 2–3, about 12 and 7–10 days, respectively.

Poison baits containing 0·66 per cent. γ BHC [*cf. R.A.E.*, A **44** 448] gave good control of the adults of *Nematocerus* in some tests, but DDT at 15 oz. per acre in emulsion sprays or at 5–13 oz. per acre in dusts gave uniformly good results. The larvae, which sampling of 4-in. soil cores showed to be present at densities of 0·5–2 million per acre, were not effectively controlled by seed dressings with various insecticides, although dieldrin, heptachlor and thiometon apparently improved the stand slightly in one test. Spray applications did not reduce larval populations, but fallowing reduced subsequent attack by the adults. This, the avoidance of double cropping, and insecticidal control of the adults are recommended.

Wheatley (P. E.). **The insect pests of agriculture in the Coast Province of Kenya. III—Sweet potato.**—*E. Afr. agric. For. J.* **26** no. 4 pp. 228–229. Nairobi, 1961. **IV—Coconut.**—*Op.cit.* **27** no. 1 pp. 33–35.

The first of these two parts of a series [*cf. R.A.E.*, A **49** 570] contains brief accounts of the bionomics, injuriousness and control of the three main

pests of sweet potato in the Coast Province of Kenya, *Cylas puncticollis* Boh., *Alcidodes* spp. (*A. erroneus orientalis* (Chevr.) and *A. dentipes* (Ol.)) and *Aegeria* sp., and notes on three minor pests. Similar information is given in the second part for the two principal pests of coconut, *Oryctes monoceros* (Ol.) and *Pseudotheraptus wayi* Brown, and several minor pests. A few of the larvae of *O. monoceros* are parasitised by *Scolia ruficornis* F., and the adults are attacked by the Reduviid, *Platymeris rhadamanthus* Gerst., but neither causes any appreciable reduction in numbers [*cf.* **48** 311]; *Pseudotheraptus* is attacked by *Oecophylla longinoda* (Latr.) [*cf.* **47** 169], and the encouragement of this ant by intercropping coconut with cashew, which it favours, is suggested.

Jones (T.). **A note on** *Analeptes trifasciata* **Fabr. and** *Paranaleptes reticulata* **Thoms. (Coleop. Lamiinae) two tree girdling beetles of tropical Africa.**—*E. Afr. agric. For. J.* **27** no. 1 pp. 36–39, 4 figs., 4 refs. Nairobi, 1961.

The following is substantially the author's summary. An outbreak of stem girdling on kapok (*Ceiba pentandra*) in northern Ghana is described and attributed to *Analeptes trifasciata* (F.). A record of similar damage to another tree is quoted from Uganda, and instances of *Paranaleptes reticulata* (Thoms.) attacking various indigenous and exotic trees are reported from Kenya and Tanganyika. The latter insect is considered to be a potential pest of kapok and cashew (*Anacardium occidentale*), and simple control measures are suggested. The wild food-plants of both Lamiids are discussed, and it is suggested that indigenous Bombacaceae are the natural food-plants, but that they may be supplemented by exotic species.

Nye (I. W. B.) **Changed nomenclature of the African coffee berry moth.**—*E. Afr. agric. For. J.* **27** no. 1 p. 55, 3 refs. Nairobi, 1961.

The coffee berry moth, which is widely distributed in the Ethiopian region, has hitherto been referred to as *Thliptoceras octoguttale* (Fldr. & Rogenh.). Comparison of 35 moths bred from coffee berries in Tanganyika with the male holotype of *T. octoguttale* and the female holotype of *Pyralis smaragdina* Btlr. showed them to be conspecific with the latter. The two species concerned are congeneric with each other but not with the type species of *Thliptoceras* (*T. variabile* Warr. in Swinh.). *Prophantis*, which was considered by Hampson as not distinct from *Thliptoceras* and of which *P. octoguttalis* is the type species, is reinstated for the latter and the coffee berry moth, *P. smaragdina*.

Arambourg (Y.). **Contribution à l'étude de** *Prays oleaellus* **Fabr. (Lep. Hyponomeutidae) en Tunisie. Cycle biologique et essais de lutte en 1957.**—*Ann. Serv. bot. Tunis.* **30** (1957) pp. 47–72, 8 graphs, 1 fldg. table, 9 refs. Ariana, 1960.

Observations were made in 1957 on the bionomics and control of *Prays oleellus* (F.) on olive near Sfax, in south-eastern Tunisia. Details are given of the annual cycle of development of the moth, comprising a leaf-infesting (winter) generation, of which the larvae were present in October–March, and two summer ones, in April–May and May–October, infesting the flowers and fruits, respectively. Two parasites emerged from pupae transferred to

the laboratory, *Chelonus* (*Chelonella*) *elaeaphila* Silv. and *Apanteles xanthostigmus* (Hal.), but parasitism did not exceed 10 per cent.

Experiments were carried out with sprays of demeton and methyl-demeton applied at 1 pint in 87·5 gal. water per tree, against larvae of each generation. The first application was made in February against larvae in and on the leaves; demeton gave 29·6 per cent. mortality after 7 days and 72·9 per cent. after 14, and methyl-demeton gave 22·8 and 71·4 per cent., respectively. The second application was made in April, against the flower-infesting larvae; demeton gave 29·3, 57·2 and 75 per cent. kill and methyl-demeton 26, 48·4 and 61·4 per cent. after 4, 8 and 12 days, respectively. The third application was made in May against the fruit-infesting larvae; demeton gave 17·9, 34·3, 23 and 97·4 per cent. kill and methyl-demeton 9·6, 37·2, 32·1 and 96·2 per cent. after 1, 2, 3 and 4 weeks, respectively. There was also some mortality of eggs.

The translocation of systemic insecticides in olive trees was tested by covering some of the branches of trees 60 years old and spraying the remaining branches in July with methyl-demeton; no larvae were killed in olives on the covered branches, whereas there was 96·2 per cent. mortality after three weeks on the uncovered ones. The fall of olives caused by the fruit-infesting larvae, which normally reaches peaks in June and October, was studied on trees sprayed with both materials in May 1957; it was found to be considerably reduced by the treatments, although there was a heavy fall in October owing to infestation by *Dacus oleae* (Gmel.). In the final experiment, begun in mid-June, demeton applied at 1 pint in 175, 87·5, 58·33 and 43·75 gal. water per tree was compared with methyl-demeton at 1 pint in 87·5, 43·75, 29·166 and 21·875 gal. Demeton gave 100 per cent. mortality after three weeks at the two higher rates and after four weeks at the two lowest, whereas methyl-demeton gave complete kill only at the two higher rates, after four weeks.

It is concluded that both materials are effective against all generations of *P. oleellus*, but as they are not readily translocated in olive trees, especially in old ones, the trees should be carefully sprayed all over, and methyl-demeton should not be used below the strength of 1 pint in about 30 gal. water. Treatment should be carried out at the beginning of the oviposition period of the winter generation in order to protect the flowers and at fruit-set before the formation of the oil in order to destroy the fruit-infesting larvae without leaving toxic residues in the olives.

Frézal (P.). **Essai de lutte généralisée contre la mouche méditerranéenne (*Ceratitis capitata* Wied.) à l'aide d'appâts insecticides.**—*Ann. Epiphyt.* **11** no. 1 pp. 5–33, 4 figs., 1 fldg. graph, 4 refs. Paris, 1960.

In view of earlier results in Algeria on the control of *Ceratitis capitata* (Wied.) with poison bait-sprays containing protein hydrolysate [*cf. R.A.E.*, A **47** 9], the application of this method to the protection of *Citrus* crops was investigated in 1957–59. Adults of the Trypetid are found in *Citrus* groves throughout the year, but are commonest in June–December, with peak populations in July and September–October caused by migration from other fruit crops. A large area in the Mitidja, planted with varieties with different fruiting periods, was selected, and the progress of infestation was followed by the use of traps distributed at the rate of 1 per 2·5 acres and baited with angelica-seed oil, [*cf.* **46** 349], which was the most effective of several attractants tested, including siglure and its isopropyl homologue, isopropyl 6-methyl-3-cyclohexene-1-carboxylate [*cf.* **47** 184; **48** 29], and had the

advantage of attracting mainly males. This avoided interference with assessment of the results by counts of punctured fruits. The bait-sprays contained 5 lb. malathion and 9 lb. protein hydrolysate in 10 gal. water, and were applied at 0·9 gal. per acre by helicopter four times between mid-September and the end of October 1958, as indicated by the results of trapping, though delays sometimes occurred. The results showed that the percentages of fruits punctured were 0–0·08 in the experimental area, which was commercially satisfactory. In a smaller test, carried out at Boufarik, the percentages punctured varied from 0·6 to 1·55, and they were 3·64–5·66 in small-plot tests at a third place, as compared with 16·21 for no treatment.

The attractiveness of poison-bait formulations was investigated by using them in traps; the most effective contained 0·6 per cent. protein hydrolysate and 0·9 per cent. of a 50 per cent. malathion emulsion concentrate. Deodorised malathion was less successful, and malathion wettable powder reduced attractiveness by altering the consistency of the bait. The cost of the treatment is discussed.

Hurpin (B.). **Recherches sur l'alimentation des vers blancs ou larves de *Melolontha melolontha* L. (Coléopt. Scarabaeidae).**—*Ann. Épiphyt.* **11** no. 1 pp. 35–80, 13 figs., 2 fldg. graphs, 26 refs. Paris, 1960.

The nutrition of the larvae of *Melolontha melolontha* (L.) was investigated in 1949–57 in France in the laboratory and in small field plots. The quantities of food taken were determined by rearing larvae individually in the laboratory, pieces of carrot or potato or roots of *Poa annua* being provided in the rearing containers and the amounts consumed being measured by weighing every seven days for the first two instars and thereafter every 15 days. On the average, each larva in the course of its development consumed about 60 g. carrot, the greatest quantity being taken from the beginning of the third instar onwards; the grass roots were eaten in much less amounts, and potato in the least. In other tests, the roots of 33 plants, mostly weeds, were supplied to single larvae, and it was found that the effects on survival and development were of three types. Some plants, including potato, were apparently toxic, others, including most grasses and cereals, were poor sources of nourishment, and carrot, beet and the roots of several Compositae were highly favourable.

Field-plot tests showed a marked lack of correlation between the suitability of plants for feeding and the degree of damage caused. Several plants unfavourable to the larvae, including meadow grasses, were severely damaged, while some plants highly favourable to development showed little injury. This was correlated with both the structure and the food value of the roots; some highly nutritious roots supported the larvae without being unduly damaged, especially those of fibrous growth such as plantain (*Plantago lanccolata*), but dandelion (*Taraxacum officinale* (*dens-leonis*)) the tap-roots of which were highly nutritious, was severely injured. In the presence of plants of more than one species, the larvae were found associated with those providing better conditions for development, plantain or beet supporting significantly greater numbers than rye-grass (*Lolium perenne*) or potato. For grasslands, especially, the concept of a threshold tolerance for the survival of a plant species in the presence of populations of the Melolonthid is more difficult to define than has been thought. It seems that poor pastures containing weeds suitable for the growth of the larvae form foci from which neighbouring fields are infested, and their improvement should form part of any campaign for the control of this species. The selection of resistant strains of plants may also be of value.

Bonnemaison (L.). **Remarques sur la diapause de la noctuelle du chou:** *Mamestra brassicae* **(L.) (Lep.).**—*Bull. Soc. ent. Fr.* **64** (1959) no. 7–8 pp. 142–151, 5 graphs, 6 refs. Paris, 1960. **Elimination de la diapause chez la noctuelle du chou** (*Mamestra brassicae* **L.) (Lep. Noctuidae).**—*Op. cit.* **65** no. 3–4 pp. 73–78, 4 graphs, 8 refs.

In the region of Paris, *Mamestra brassicae* (L.) has two generations a year and hibernates in the pupal stage; adults of the overwintered generation are present in May–July and those of the first generation in July–September. In the investigations described in the first paper, larvae were reared throughout the year on cabbage leaves, and the effects of different combinations of temperature and daily photoperiod on the proportion of pupae entering diapause [*cf. R.A.E.*, A **47** 33] were studied in successive generations descended from a single pair.

Each set of tests included a batch reared at 20°C. [68°F.] and with a daily photoperiod of 16 hours, under which conditions the percentage of pupae entering diapause was low or nil. With 12 hours illumination at 20°C., either throughout the larval period or in the first four instars only, 30–100 per cent. of the pupae entered diapause, and this tendency seemed especially marked in the third and seventh generations after one that had undergone diapause. The pupal stage lasted up to 70 days at 20–25°C. [68–77°F.] in examples that did not enter diapause, 70–85 per cent. emerging in 30 days at 20°C. and 80 per cent. in 50 days at 25°C., and the males emerged before the females. In those that underwent diapause, the pupal period was 110–360 days or longer, and the males emerged after the females. The optimum period of illumination for the induction of diapause was 9–12 hours at temperatures of 18–22°C. [64·4–71·6°F.], and even a constant temperature of 28°C. [82·2°F.] did not inhibit diapause when there was less than 12 hours of illumination. Larvae were affected by the factors governing the onset of diapause in all six instars, but the most sensitive stage varied with the particular experimental conditions; in general, sensitivity was greater in the later instars, especially the fifth and the early part of the sixth.

In the second paper, the author describes tests of the effects on the duration of the pupal diapause of a range of temperatures applied to prepupae and pupae in different combinations [*cf.* **46** 363]. Pupae in diapause were kept for the first ten days of pupal life at 26°C. [78·8°F.] and then for 20–95 days at 5°C. [41°F.], after which they were returned to 26°C.; there were no emergences in a control batch kept at 26°C. for 120 days, but occasional adults emerged from pupae that had been kept at 5°C. for 20–50 days, and there was complete emergence from those kept at 5°C. for 80–95 days during the 12–15 days that followed transfer to 26°C. Similar pupae from larvae reared at 20°C. and 8 hours daily illumination were divided into six lots of 40 each, which were placed for 0·5 or 10 days at 20°C. and then for 30 or 60 days at 5°C., and were then kept at 20°C. In all cases, the longer periods at 5°C. led to earlier emergence, and the figures suggested that 60 days at that temperature was just insufficient for complete termination of the diapause. To test this, a series reared at 20°C. and 12 hours daily illumination, to give a strongly established diapause, was compared with one transferred to 16 hours light for the fifth and sixth instars. The threshold duration of exposure to cold for termination of the diapause appeared to be 70 days, but the influence of cold was not absolute, since the series reared under conditions leading to strongly established diapause showed reduced emergence as compared with the other.

Féron (M.) & Vidaud (J.). **La mouche du carthame** *Acanthiophilus helianthi* **Rossi (Dipt. Trypetidae) en France.**—*Rev. Path. vég.* **39** fasc. 1 pp. 1–12, 6 figs., 7 refs. Paris, 1960. (With a summary in English.)

Safflower (*Carthamus tinctorius*) was introduced into the south of France as an oilseed crop in 1942, but was so severely attacked by *Acanthiophilus helianthi* (Rossi) that by 1953 it had almost ceased to be grown. Losses of 40–50 per cent. were observed at Tarascon in 1958, and 90–95 per cent. of the flower heads of an experimental crop at Montfavet were attacked in 1959. Similar heavy infestation has been reported in other countries [*R.A.E.*, A **30** 317; **31** 227].

Investigations on the bionomics of the Trypetid were begun in 1949, the techniques used including catching with nets and bait-traps, followed by dissection of the females, and sampling of flower heads. Nine other species of Trypetids were taken, and the other insects observed on safflower included *Heliothis peltigera* (Schiff.), which fed on the leaves and flower heads. *A. helianthi* was found to produce two generations on the crop; females appeared in late May and early June, and oviposition occurred in June, the eggs being laid in batches of 6–20 in slits cut with the ovipositor in the lower part of the bracts of the young flower heads. The larvae hatched in 1–2 days and fed in the heads, completely hollowing them out. Larval mortality was high, owing to exudation of gum from the damaged bracts; only four larvae survived to pupate from every ten eggs laid. The larval stage lasted 8–12 days, and pupation took place in the flower head; the adults emerged 9–10 days later. As the flower heads developed, the eggs were laid in the upper part, and the damage done by the larvae was then less extensive; some florets survived to set seed. The first-generation adults emerged at the end of June, at which time the flowers were opening. Eggs were laid in July, and larvae developed, but the damage by the second generation was relatively unimportant.

Control by insecticides, to be effective, should be so planned as to prevent attack by larvae of the first generation; protection is needed for at least a month from the first week in June. In 1959, a formulation containing 8 per cent. dieldrin and 3 per cent. lindane [almost pure γ BHC] was applied in a spray at 1·8–2·7 lb. per acre at intervals of 4–5 days, beginning with the appearance of mature females; high winds and a poor crop vitiated the experiment, but it was thought that some protection was obtained. As the degree of damage has been stated to be less on varieties with hard, spiny bracts, it is suggested that attention should be directed to varieties of this nature, those producing copious gum at the oviposition puncture, and fast-growing, early-flowering varieties.

Coutin (R.) & Colombin (A.). **Les principaux parasites de** *Laspeyresia pomonella* **L. dans le bassin parisien.**—*Rev. Path. vég.* **39** fasc. 1 pp. 35–45, 4 figs., 10 refs. Paris, 1960. (With a summary in English.)

A survey of the parasites of *Cydia* (*Laspeyresia*) *pomonella* (L.) was carried out in 1951–54 in north-western France, host material being obtained by collecting hibernating larvae in bands of corrugated cardboard on apple trees; emergence took place in outdoor cages. Of the 15 species observed, the four commonest were *Pristomerus vulnerator* (Panz.), *Trichomma enecator* (Rossi), *Ascogaster quadridentata* Wesm., and *Elodia tragica* (Mg.). Six species not recorded by Rosenberg [*R.A.E.*, A **22** 491] were found, *Pimpla turionellae* (L.), *Ephialtes caudatus* (Ratz.), *Perilissus dissimilis*

Woldst., *Herpestomus nasutus* Wesm., *Campoplex* (*Eulimneria*) *rufifemur* (Thoms.), and *Holocremnus sinuatus* Thoms. The chief of the less common parasites was *E. caudatus*. The times of emergence of the parasites in relation to that of the host were found to be characteristic; *T. enccator* and *Elodia tragica* emerged before it, and *A. quadridentata* and *Pristomerus vulnerator* simultaneously with it. The rate of parasitism was low, especially in orchards near towns and those that were carefully sprayed. It is thought, however, that parasites play a part under certain conditions and that they should be protected from ill-timed spraying operations.

D'Aguilar (J.). **Note préliminaire sur la biologie de** *Suillia lurida* **Meig. (Dipt. Helomyzidae).**—*Rev. Path. vég.* **39** fasc. 3 pp. 173–174, 6 refs. Paris, 1960.

In 1959 and 1960, samples of garlic and leeks from the French departments of Puy-de-Dôme, Vaucluse and Basses-Alpes were found to be infested by larvae of *Suillia lurida* (Mg.). The damage resembled that caused by *Acrolepia assectella* (Zell.) or, more particularly, *Hylemyia* (*Phorbia*) *antiqua* (Mg.), affected plants showing a small hole at the level of the neck and damage to the young leaves. Single larvae of the Helomyzid mined in the stems, leading to decomposition of the tissues.

Descarpentries (A.). **Une nouvelle espèce de** *Sphenoptera* **parasite des arbres fruitiers en Iran (Col. Buprestidae).**—*Rev. Path. vég.* **39** fasc. 4 pp. 175–180, 12 figs., 8 refs. Paris, 1960. (With a summary in English.)

The author describes the adults of both sexes of *Sphenoptera davatchii*, sp. n., and gives a key for its separation from allied species. This Buprestid is a widely distributed pest of stone fruit trees in Persia. A. Davatchi reports that the eggs are laid on the trunks close to the ground; the larvae bore in the cambium layer, and pupate in the wood. The adults emerge in May–August.

Jacquiot (M. C.), Breuzard (M.), Guillemain (J.) & Lapetite (D.). **Sur les possibilités d'emploi de l'acide borique et des borates pour la protection des bois.**—*Rev. Path. vég.* **39** fasc. 4 pp. 181–195, 6 figs., 24 refs. Paris, 1960. (With a summary in English.)

Tests of the effectiveness of boron compounds for protecting timber from damage by *Lyctus brunneus* (Steph.), *Hylotrupes bajulus* (L.) and fungi are described. When samples of veneer made from *Triplochiton sideroxylon* were impregnated with a mixture of 4 per cent. boric acid and 0·4 per cent. borax (added to reduce the acidity) and exposed to oviposition by *L. brunneus*, only two out of 16 were attacked, and radiographic examination after two months showed that the resulting larvae were dead, whereas complete development of the Lyctid occurred in untreated samples. The total content of boron expressed as boric acid was 0·3–0·39 per cent. of the dry weight of the treated wood, but it was thought that the attacked parts had received a lower dosage. Similar results were obtained in a second test, and it was found that the attacked zone contained 0·28 per cent. boric ion, as compared with 0·38–0·46 per cent. in the parts not attacked. Larvae of *H. bajulus* were introduced into samples of pine sapwood impregnated with a solution containing 0·76 or 2·28 g. boric acid with one-tenth the amount

of borax per 100 g. of solution or with one containing 5·32 g. boric acid and 8·16 g. borax (resulting in the formation of sodium pentaborate), and examined radiographically at intervals for six months. At the lowest dosage, at which the wood contained 0·77 of its dry weight of boric acid, the larvae died of starvation in 3–6 months. The results with the other solutions were similar, except that some of the older larvae pupated and gave rise to adults. Treatment of timber to give a boric acid content of 0·3 and 1 per cent. of its dry weight is recommended for protection against *L. brunneus* and *H. bajulus*, respectively, except when the wood is to be used in damp situations where the chemical may be leached out.

Maillet (P. L.). **Sur le parasitisme d'oeufs de la cicadelle verte** (*Cicadella viridis* **L.) par un hyménoptère Mymaridae:** *Anagrus atomus* **(L.) forme** *incarnatus* **Hal. Contribution à l'étude des homoptères auchénorhynques. III.**—*Rev. Path. vég.* **39** fasc. 4 pp. 197–203, 9 figs., 10 refs. Paris, 1960. (With a summary in English.)

In the Rennes district of France, many eggs of *Tettigella* (*Cicadella*) *viridis* (L.) collected between 20th April and 12th May were found to be parasitised by *Anagrus atomus* (L.). The first adults of the Mymarid emerged on 23rd April; nearly 300 were examined and found to represent form *incarnatus* Hal.

The classification of the parasite and the morphology of the eggs and larvae are discussed. The sex ratio was about 1:1; the size of the adults was very variable, according to the number developing in the host egg, which varied from one to eight. A single parasite in an egg was generally female, while more than three per egg were usually all males. Pairing was observed, and the females oviposited from the day of emergence, often in eggs of *T. viridis* already containing larvae of their own species; the larval stage lasted about 20 days. The resulting adults died within 4–7 days of emergence, indicating that there must be several generations a year. By the end of August, when the adults emerged, eggs of *T. viridis* are no longer available, so that the parasite is doubtless not confined to this host [*cf. R.A.E.*, A **27** 115].

Coutin (R.) & Lapeyronie (A.). **Contribution à la connaissance de** *Dasyneura sampaina* **Tavares (1902), la cécidomyie des pousses de lin.**—*Rev. Path. vég.* **39** fasc. 4 pp. 211–216, 10 figs., 15 refs. Paris, 1960. (With a summary in English.)

In May 1952, larvae of *Dasyneura sampaina* Tavares were found attacking flax in the Rennes district of France. They occurred in galls formed at the tips of the shoots, in a cavity surrounded by stunted leaves; pupation occurred inside the galls. All stages of the Cecidomyiid are described, including the hitherto unknown adult male, and records of its occurrence on several species of *Linum* and one of *Radiola* are reviewed. It is thought that another food-plant is attacked later in the year, since development on flax was completed by June.

Jourdheuil (P.). **Observations sur les altises du lin; remarques sur la biologie et les méthodes de lutte.**—*C.R. Acad. Agric. Fr.* **46** no. 8 pp. 477–480, 7 refs. Paris, 1960.

Observations on the bionomics of *Longitarsus parvulus* (Payk.) and *Aphthona euphorbiae* (Schr.) on flax in the Paris region showed that the

overwintered adults of these flea-beetles appear as soon as the temperature reaches 15–20°C. [59–68°F.], sometimes as early as March. They pair and feed on the young flax seedlings, and eggs are laid in cracks in the soil between early April and the end of June or beginning of July. The larvae hatch in 10–14 days at 20°C., feed on the roots, and give rise to new adults in July; these feed, but do not pair until the following spring. The adults are attacked by several micro-organisms and are parasitised by Braconids of the genus *Microctonus*, which are themselves sometimes parasitised by *Mesochorus phyllotretae* Jourdheuil. These parasites become active only at the end of the reproductive period of their hosts, and therefore give little control.

The various types of damage caused to flax by the flea-beetles are described. Damage to the roots by the larvae is more severe in the case of young seedlings than in that of older plants. The adults attack the cotyledons and stems of seedlings, usually killing them, and the still tender parts of older plants, such as the leaf-clusters and shoot-tips; the summer adults also feed on the seed-capsules. The woody parts are not damaged, and the number of adults on a plant decreases as it grows older, apparently as a result of migration to other food-plants as yet unknown. Flax should therefore be sown as early as possible, so that the plants become well established before the spring infestation and mature before the appearance of the summer adults. Wet weather favours the growth of the plants while decreasing the activity of the beetles. Methods of control having given somewhat limited results, protection by coating the seeds with γ BHC (lindane) and an oil adhesive is recommended.

Buhl (C.). **Beobachtungen über vermehrtes Schadauftreten der Kohlschotenmücke (*Dasyneura brassicae* Winn.) an Raps und Rübsen in Schleswig-Holstein.** [Observations on increased infestation by *D. brassicae* on rape and turnip rape in Schleswig-Holstein.]—*NachrBl. dtsch. PflSchDienst* **12** no. 1 pp. 1–6, 5 figs., 10 refs. Stuttgart, 1960. (With a summary in English.)

Infestation of rape in Schleswig-Holstein by *Dasyneura brassicae* (Winn.) increased after 1947 with an increase in the cultivation of the crop, and 39 per cent. of the pods taken from the edges of fields in 1954 were found to be infested, as compared with only 6·2 per cent. in 1945. Investigations on the bionomics of the Cecidomyiid were carried out in 1954–58, and the following is based mainly on the author's summary of the results. There were three generations a year, the adults of the overwintered one ovipositing in winter rape and turnip rape and those of the first (which was the most numerous) and second mainly in summer rape. The appearance of the overwintered and first-generation adults coincided with the beginning of the period of full-bloom of the winter and summer crops, respectively. Some larvae of all generations remained in the soil for prolonged periods, ranging up to five years or more. The flight periods are compared in graphs with those of *Ceutorhynchus assimilis* (Payk.), infestation by which is the main factor predisposing the plants to attack [*cf. R.A.E.*, A **48** 85]. The most numerous parasite was *Prosactogaster* sp., which had at least three generations a year. This Proctotrupid oviposits in the host eggs and completes its development in the larvae, and averages of 17·9 and 6·9 per cent. of first- and second-generation larvae, respectively, were parasitised by it. For control, the edges of the fields should be treated with an insecticide harmless to honey bees, such as Thiodan.

Mayer (K.). **Der Einfluss der Entwicklung des Hafers auf die Populationsdichte der Fritfliege.** [The influence of the stage of development of oats on the population density of *Oscinella frit.*]—*NachrBl. dtsch. PflSch-Dienst* **12** no. 2 pp. 22–27, 4 figs., 10 refs. Stuttgart, 1960. (With a summary in English.)

Investigations near Berlin in 1959 in which blue dishes were used to trap adults of *Oscinella frit* (L.) in fields of oats [*cf. R.A.E.*, A **49** 456] showed that the population was usually higher on late crops than on earlier ones, and this difference was reflected in the damage caused. There was no difference in the degree of infestation of two varieties of oats, but variations were noted that appeared to be related to the stage of development of the plant and to the treatment applied to the seed, which probably affected plant physiology.

Waede (M.). **Über den Gebrauch einer verbesserten Lichtfalle zur Ermittlung der Flugperioden von Gallmücken.** [On the use of an improved light-trap for the determination of the flight periods of gall-midges.]—*NachrBl. dtsch. PflSchDienst* **12** no. 3 pp. 45–47, 3 figs., 3 refs. Stuttgart, 1960. (With a summary in English.)

Traps for collecting gall-midges emerging from the soil normally consist of wooden frames either covered at the top with cheesecloth and coated on the inside with an adhesive or covered with roofing felt and having glass tubes at the sides into which the insects are attracted by light. A new trap is described and illustrated that was designed to permit better air circulation and to allow rain to wet the soil, so as to prevent it from becoming hot or dry. It consists of a metal frame 19·5 in. square and 7·8 in. high, kept covered with a lid of silk gauze (which allows good permeation of water) except for 30 minutes each day, when it is replaced by a cover of roofing felt that darkens the interior and allows the insects that have emerged to be attracted into a jar screwed into one side of the frame and fitted with a cone entrance. Tests with the new traps in a rape field near Kiel in 1959 during the emergence period of the second generation of *Dasyneura brassicae* (Winn.) showed that the dates of first emergence and of maximum emergence observed corresponded with those determined by examination of cocoons taken from the soil.

Waede (M.). **Versuche zur Bekämpfung der Kohlschotenmücke** (*Dasyneura brassicae* **Winn.) in blühenden Ölfruchtbeständen mit Hilfe des Kaltnebelverfahrens.** [Tests on the control of *D. brassicae* in flowering rape stands by means of cold aerosols.]—*NachrBl. dtsch. PflSchDienst* **12** no. 5 pp. 65–70, 2 figs., 19 refs. Stuttgart, 1960. (With a summary in English.)

The best time for the application of insecticides against *Dasyneura brassicae* (Winn.) on rape in Schleswig-Holstein coincides with the full-bloom of the crop [*cf. R.A.E.*, A **49** 659], when the activity of honey bees is at a maximum. In tests on winter rape in May 1959, materials relatively harmless to bees were applied in the form of aerosols shortly after the beginning of the period of full-bloom. The effect on *Ceutorhynchus assimilis* (Payk.), of which the adults occurred at about the same time, was also assessed. Examination of pods 4–5 weeks before harvest showed that 6·5 per cent. of those treated with Thiodan at 1·35 lb. per acre were or had been infested by first-generation larvae of *D. brassicae*, as compared with 13·9 per cent. for no treatment. The corresponding percentages for a similar amount of toxaphene were 10·1 and 33·7, and for DDT (tests on the possible

non-toxicity of which to bees in aerosol form are being made) they were 12 and 27·1. It is considered that better results would have been achieved had the treatment been carried out about a week later, when full-bloom and adult flight were at a maximum. The percentage of pods infested by *C. assimilis* was, so far as could be determined, 7 for Thiodan, as compared with 11·5 for no treatment, but there appeared to be no reduction for the other insecticides. The percentage infested by second-generation larvae of *D. brassicae* was 0·6 for Thiodan, as compared with 2·9 for the untreated plants. This reduction, which did not follow the other treatments, must have been due largely to control of *C. assimilis*, which facilitates oviposition by the Cecidomyiid [*cf. loc. cit.*].

Zachariae (G.). **Kann sich der Speisebohnenkäfer** *Acanthoscelides obtectus* **Say als Freilandschädling in Norddeutschland einbürgern? (Coleoptera: Bruchidae).** [Can *A. obtectus* become established as an outdoor pest in northern Germany?]—*Z. angew. Ent.* **45** pt. 3 pp. 225–267, 16 figs., 56 refs. Hamburg, 1960. (With a summary in English.)

From earlier observations on the behaviour of *Acanthoscelides obtectus* (Say) on beans in the field near Hamburg [*cf. R.A.E.*, A **49** 202] and laboratory investigations, which are described, the author discusses the climatic and other conditions in the area and characteristics of the Bruchid that favour infestation in the field. The danger of sowing infested seeds is apparently not always appreciated, owing to the fact that, as long as the embryo is not destroyed, infested seeds germinate more rapidly than uninfested ones, being better able to absorb water, but the practice only leads to the spread of infestation. Sometimes adults (or even pupae) introduced with seed into the soil are brought to the surface only by the developing seedlings, but air temperatures are sufficiently high for sexual maturity to be reached. Temperatures high enough to allow oviposition usually occur up to the end of September, and oviposition is possible even in summers with unfavourable weather. Eggs laid in the pods in August (but rarely those laid in September) presumably develop in the field if the plants are left there long enough, but there appeared to be no possibility for *A. obtectus* to survive the winter in the open. In laboratory tests, 50 per cent. of males and females fed with honey and water lived for at least 84 and 82 days, respectively, and females kept with males preserved their ability to oviposit for a similar period. The investigations suggest that the Bruchid is not really adapted to conditions in northern Germany, since it overwinters only indoors, and that its occurrence in the field in the post-war years was due mainly to the increase in the cultivation of beans. Infestation almost disappeared when normal conditions were restored. The origin of the Bruchid is discussed in an appendix, and the mountains of South America are suggested as its original home.

Berg (W.). **Zur Kenntnis der Obstbaumminiermotte** *Lyonetia clerkella* **L. unter besonderer Berücksichtigung des Massenwechsels während der Jahre 1951 bis 1953. Teil I.** [On knowledge of *L. clerkella* with particular reference to the changes in population during the years 1951–53. Part I.]—*Z. angew. Ent.* **45** pt. 2 pp. 157–187, 17 figs. Hamburg, 1959. **Teil II.** [Part II.]—*T.c.* pt. 3 pp. 268–303, 15 figs., 4 pp. refs. 1960. (With a summary in English.)

Unexpectedly large numbers of *Lyonetia clerkella* (L.) occurred on fruit trees, particularly cherry, in central Europe in 1948–49. All stages of this pest are described, its distribution, food-plants, bionomics and control are

reviewed from the literature, and the results are given of detailed investigations on its bionomics and population dynamics carried out in 1951–53 in the Rhineland, where, however, the outbreak collapsed in 1951–52 and damage became unimportant. Its bionomics and morphology are compared with those of a peach leaf-miner, thought to be *L. clerkella*, in Japan [*cf. R.A.E.*, A **7** 439; **22** 239], and it is concluded that the latter is not *L. clerkella*.

Evidently only the adults overwintered, but the numbers doing so are probably small, and no overwintering adults were found. In summer, males and females occurred in about equal numbers. Eggs were laid in the lower surfaces of the leaves, and one female that was dissected contained 120–130 eggs in various stages of maturation. The larvae mined individually in the leaves until shortly before pupation and then spun cocoons, usually on the lower leaf surfaces but sometimes on the trunks or branches. At 20°C. [68°F.] in the laboratory, the eggs hatched in 5–6 days, the first and second larval instars and the third instar within the mine lasted 3–4, 3–4 and 7–8 days, respectively, and the remainder of the larval stage and the pupal stage lasted 1–3 and 8–11 days. There were three generations in 1951, when the third-instar larvae were present in May–June, July and August–September, respectively, and four in 1952 and 1953, when they were present in May, June–July, July–August and September.

After sweet and sour cherries, apple was the most heavily infested tree. Quince and medlar showed considerable attack, but plum very little and peach and apricot none at all. The decline in numbers of *L. clerkella* during the period and the climatic, biotic and other factors involved are discussed. Summer temperatures appeared to have no decisive effect on the population, and the temperature in April, which influences the date of resumption of activity by the adults, was probably the factor determining the number of generations in the year. Winter temperatures are considered to be crucial. Parasitism was of limited importance, though up to 83 per cent. of the larvae and pupae were parasitised in 1953. Of the parasites that had most effect, the commonest were *Pnigalio longulus* (Zett.), which attacked the larvae and pupae in their cocoons, a species of *Chrysocharis*, possibly *C. aeneiscapus* (Thoms.), that completed its development in the mines, and a species of *Angitia* close to *A. nana* (Grav.) that attacked the first-generation larvae in their mines and completed its development in the cocoons. Predators and diseases were of no importance. There was considerable mortality of young larvae from an unknown cause in 1951 and 1952, reaching about 90 per cent. in the second generation of 1952 in one locality and nearly 100 per cent. in another, but it did not occur subsequently.

In tests on control in 1951 and 1952, good or fairly good results against young larvae were given by sprays of BHC, DDT, parathion (E 605 forte), demeton (Systox) or nicotine and a mixture of parathion and lead arsenate. Results with the same sprays against older larvae were generally unsatisfactory.

Flaschenträger (B.), Jarczyk (H. J.) & Hafez (M.). **Contributions to the biology and biochemistry of the Egyptian cotton leaf-worm** *Prodenia litura* **Fab. II. On the collection, breeding and health of** *Prodenia litura* **Fab. in Egypt during 1956.**—*Alexandria J. agric. Res.* **6** no. 1 pp. 15–23, 9 refs. Alexandria, 1958. (With a summary in Arabic.)

Hammad (S. M.) & Jarczyk (H. J.). **III. The morphology and histology of the sexual scent glands in the female moth of** *Prodenia litura* **F. (Lepidoptera: Agrotidae–Zenobiinae).**—*Bull. Soc. ent. Egypte* **42** pp. 253–261, 5 figs., 12 refs. Cairo, 1958.

Jarczyk (H. J.) & Hertle (P.). **IV. Further investigations on the prepupal and pupal stage and on the emergence of female and male moths.**—*Z. angew. Ent.* **45** pt. 1 pp. 94–102, 5 graphs, 4 refs. Hamburg, 1959. **V. Studies on the mating capacity of female and male moths.**—*T.c.* pt. 3 pp. 304–312, 1 graph, 10 refs. 1960. (With summaries in German.)

In the second part of this series [*cf. R.A.E.*, A **47** 317], the authors describe the methods by which larvae of *Prodenia litura* (F.) were collected and reared on cotton in the Nile Delta for the purpose of extracting the sex-attractant from the females [*cf.* **48** 85]. Many of the larvae were infected by *Borrelina litura* [*cf.* **47** 96–97], and some 80 per cent. were attacked by this virus or by insect parasites, mainly *Tachina* sp. and *Barylypa humeralis* (Brauns).

In the third part, the morphology and histology of the sexual scent glands of the females of *P. litura* are described. The glands begin to decrease in size on the third day after emergence.

The fourth part comprises an account of laboratory studies carried out in March–November 1957 on a larger scale than those recorded in the first part of the series [**47** 317]. Males and females from eggs deposited during the same night began pupation on the same night, and pupation was at a maximum at about midnight, females reaching the peak 1–3 hours before males. The pupal stage of males and females lasted minima of about 8 and 7 days, respectively, in August at 27–29°C. [80·6–84·2°F.] and maxima of 19 and 17 days in March at 19·5–21·5°C. [67·1–70·7°F.]. The adults emerged mainly at night, females somewhat earlier than males, and adults originating from eggs laid at the same time and from larvae that pupated at about the same time emerged during a period of some three days, emergence being at a maximum at about midnight on the second day.

Laboratory studies on the mating capacity of the moths carried out in 1957 and reported in the fifth part showed that the greatest number of egg-clusters were produced when males 48 hours old paired with females 24 hours old. Pairing on one night was sufficient for deposition of fertilised eggs for about the following seven nights, and pairing on up to six further nights made little difference to the number of clusters laid. The number declined after the third night. One male could fertilise up to 8 females at the rate of 1–2 per night. A degeneration of the sexual scent glands accompanied the decrease in female mating capacity.

Gauss (R.). **Über Nahrungspflanzen-Wechsel bei Insekten.** [On changes of food-plants by insects.]—*Z. angew. Ent.* **45** pt. 3 pp. 313–316, 13 refs. Hamburg, 1960. (With a summary in English.)

Records are given from Germany of three forest insects attacking unusual food-plants. *Coleophora laricella* (Hb.), which normally attacks larch, was found on Douglas fir [*Pseudotsuga menziesii*] in northern Baden in 1956 [*cf. R.A.E.*, A **47** 104]. Although all of 14 larvae received gave rise to pupae and 11 of these to adults (6 females and 5 males), which paired when caged on *P. menziesii* and produced a total of 124 eggs on the needles (mainly on the terminal third), all the resulting larvae died within three months of hatching. When adults taken on larch were caged similarly on *P. menziesii*, eggs were laid predominantly in the same position on the needles, and the larvae also died within three months. Infestation did not recur on *P. menziesii* in 1957 or thereafter.

Liothrips setinodis (Reut.), which is occasionally observed on deciduous trees and weeds, occurred in large numbers on young pine under shade throughout the Black Forest in 1957 and had apparently been present since 1954, attacking the needles of the May shoots and causing the death of many trees. Serious damage was restricted to one locality in 1958.

Seedlings of *P. menziesii* and larch in a nursery in northern Württemberg were damaged in the autumn of 1958 by *Apatele* (*Acronicta*) *rumicis* (L.), the larvae feeding on the needles and shoots. About half the trees were affected, and about 1 per cent. died. The larvae belonged to the overwintering generation of the Noctuid, which has two generations a year and normally feeds on a variety of low-growing plants and deciduous trees.

Zoebelein (G.). **Zur Beeinflussung der Insektenfauna des Waldes durch chemische Grossschädlingsbekämpfungen. 3. Mitteilung. Vergleichende Untersuchungen des Einflusses einer DDT-Behandlung mit TIFA-Gerät und mit Hubschrauber gegen die Kieferneule in Mittelfranken 1956.** [The effect of chemical control of major pests on the insect fauna of the forest. Third communication. Comparative investigations on the effect of treatment with DDT from the TIFA apparatus and a helicopter for the control of *Panolis flammea* in central Franconia in 1956.]—*Z. angew. Ent.* **45** pt. 3 pp. 320–330, 1 graph, 8 refs. Hamburg, 1960. (With a summary in English.)

In this third part of a series [*cf. R.A.E.*, A **49** 202, etc.], the author compares the effects of a DDT aerosol applied at a rate of 0·72 lb. DDT per acre by means of the TIFA apparatus [*cf.* **35** 259] and a spray of DDT in diesel oil applied from a helicopter at a rate of 9·9 lb. DDT per acre on the arthropod fauna of a pine forest heavily infested by *Panolis flammea* (Schiff.) in Bavaria in 1956. Of the total numbers of arthropods caught on sheets spread beneath the trees, beneficial, indifferent and injurious forms comprised 2·46, 3·12 and 94·42 per cent., respectively, following application of the aerosol and 4·51, 5·51 and 89·98 per cent., respectively, following spraying from the air. Mortality of injurious forms was 90·5 per cent. 24 hours after treatment with the spray and 95 per cent. 14 hours after aerosol treatment. All species except *P. flammea* and Psocoptera (which were virtually eliminated) had regained their normal level three months after either treatment.

Petersen (B. B.). **Some observations on the mortality of *Pristiphora abietina* (Christ) and other spruce Nematini during the oviposition period, and on the effect of temperature on flight intensity.**—*Oikos* **11** fasc. 1 pp. 72–79, 1 graph, 9 refs. Copenhagen, 1960.

The following is virtually the author's summary. Climate or 'weather' as a mortality factor in insect populations is briefly discussed. Field observations on the flight of *Pristiphora abietina* (Christ) and some other spruce sawflies in Denmark were carried out in 1955–56. Flight occurred at temperatures of 11–13°C. [51·8–55·4°F.] and above. The peak of flight and oviposition took place at temperatures of about 18°C. [64·4°F.] and above. In both years, rainstorms seemed to cause high mortality among the sawflies and thereby brought the flight period to an end. Some other examples of mortality caused by climate in *P. abietina* are discussed.

Skuhravý (V.). **Die Nahrung des Ohrwurms** (*Forficula auricularia* **L.**) **in den Feldkulturen.** [The food of the earwig (*F. auricularia*) in cultivated fields.]—*Acta Soc. ent. Čsl.* **57** no. 4 pp. 329–339, 2 pls., 1 fig., 1 fldg. table, 4 refs. Prague, 1960. (With a summary in Czech.)

Observations in fields under various crops in Czechoslovakia showed that 20–25 per cent. of the food taken by *Forficula auricularia* L. consisted of animal matter, chiefly aphids, and the rest plant tissues. The earwig is thus rather more injurious than beneficial.

Sáringer (G.). **Újabb adatok a mustárbogár** (*Colaphellus sophiae* **Schall.**) **lárvák ökológiájának ismeretéhez.** [Contribution to the ecology of larvae of the mustard beetle (*C. sophiae*).]—*Rec. hung. agric. Exp. Stas* **53** (A) pt. 3 pp. 89–103, 6 figs., 16 refs. Budapest, 1960. (With summaries in Russian & English.)

The following is based on the author's summary of this account of observations in Hungary on the larvae of *Colaphellus sophiae* (Schall.), which infest mustard (*Sinapis alba*) [*cf. R.A.E.*, A **49** 443]. They feed on the lower leaves in the first two instars and on the upper ones in the last two, and also attack the stems and flowers. When larvae were kept at constant temperature and humidity, development was found to be slowest at 16°C. [60·8°F.] and most rapid at 27°C. [80·6°F.]; at 37°C. [98·6°F.], mortality reached a maximum and few larvae attained the prepupal stage. In another test, larvae kept constantly at 27°C. developed more rapidly than others kept at 22 and 27°C. [71·6 and 80·6°F.], alternating every two days. In starvation experiments, larvae of all instars lived longer when kept on a wet substrate than on a dry one. In tests of resistance to cold, larvae of all instars survived at temperatures of −1 or −2°C. [30·2 or 28·4°F.], but died under long exposure to −5°C. [23°F.]. They probably survive ground frosts, which often occur as late as mid-May.

Bognár (S.). **Megfigyelések a gyümölcsfákon élő takácsatkafajok populációs dinamikáját befolyásoló tényezőkkel kapcsolatban, különös tekintettel a DDT tartalmú készítményekre.** [Observations on the effect of various factors on the dynamics of red-spider populations, with special reference to preparations of DDT.]—*Rec. hung. agric. Exp. Stas* **53** (C) pt. 1 pp. 19–32, 2 graphs, 18 refs. Budapest, 1960. (With summaries in Russian & English.)

The following is based on the author's summary. Tetranychids have proved increasingly injurious of recent years in apple orchards in Hungary [*cf. R.A.E.*, A **48** 357]. Six of the species have been identified as *Bryobia praetiosa* Koch, *B. redikorzevi* Rekk [*cf.* **49** 571], *Panonychus ulmi* (Koch), *Eotetranychus* (*Schizotetranychus*) *carpini* (Oudm.), *Tetranychus viennensis* Zacher and *T. telarius* (L.). Observations showed that 35–55 per cent. relative humidity, a temperature of 28–31°C. [82·4–87·8°F.] and a daily photoperiod of 14–16 hours favoured the mites, and increases also resulted from the use of insecticides containing DDT or methyl-parathion. The population reaches peaks in late March and early April, in late June and early July and in early September, but the second peak was suppressed in 1959 by cool, wet weather.

Das *Trichogramma*-Problem. [The *Trichogramma* problem.]

Mayer (K.). **Verhaltensstudien bei Eiparasiten der Gattung *Trichogramma* (Hym. Chalcididae).** [Studies on the behaviour of egg-parasites of the genus *Trichogramma*.]—*Mitt. biol. Bundesanst. Berl.* pt. 100 pp. 1–10, 2 figs., 35 refs. Berlin, 1960. (With a summary in English.)

Quednau (W.). **Über die Identität der *Trichogramma*-Arten und einiger ihrer Ökotypen (Hymenoptera, Chalcidoidea, Trichogrammatidae).** [On the identity of the species of *Trichogramma* and some of their ecotypes.]—*T.c.* pp. 11–50, 4 pls., 9 figs., 77 refs. (With a summary in English.)

In the first paper, the effects on the behaviour of species of *Trichogramma* exercised by various abiotic factors and by the eggs of various hosts are reviewed, mostly from the literature [*cf. R.A.E.*, A **46** 398; **48** 549; **49** 45].

In the second, which is based on studies of living material from various parts of the world, the author discusses the criteria used for differentiating the various species and forms of *Trichogramma*, their host ranges, their geographical distribution, which is illustrated on a map, and the ecological niches occupied by the various forms, with a historical review of the nomenclature that has been applied to them. He now recognises nine species; a list of these is given, showing their synonyms, diagnostic characters, habitats, hosts and distribution, followed by figures and a key for their differentiation. They are *T. semblidis* (Auriv.), which occurs in Europe and North America and has been misidentified by many authors; *T. retorridum* (Gir.), known only from North America; *T. japonicum* Ashm., which occurs in Japan, China and Indonesia and of which the synonyms probably include *T. chilonis* Ishii and *T. jezoensis* Ishii [*cf.* **30** 14–15]; *T. evanescens* Westw., which occurs mainly in Europe, but is also known from Egypt, of which the synonyms include *T. turkestanicum* Meĭer [**30** 298] and which has been misidentified by many authors; *T. fasciatum* (Perkins), which occurs mainly in North and South America, was considered by Flanders to be a grey form of *T. minutum* Ril. occurring in Louisiana [**19** 71], and was misidentified as *T. evanescens* by Lund in 1938 [**26** 545]; *T. australicum* Gir., which occurs in Australia, Madagascar and Mauritius; *T. semifumatum* (Perkins), which occurs in California, Mexico and Hawaii [*cf.* **49** 600] and was considered by Flanders to be a dark race of *T. minutum* occurring in Mexico [**19** 71]; *T. embryophagum* (Htg.), occurring only in Europe, which has been misidentified by many authors and of which *T. piniperdae* Wolff [**7** 453; **12** 98], *T. cacoeciae* Marchal [**46** 398] and *T. pini* Meĭer [**30** 298] (treated by Telenga as a form of *T. cacoeciae* [**48** 362]) are considered synonyms; and *T. minutum*, which occurs in the United States, Canada and southern Russia and of which the synonyms include *T. pretiosum* Ril. [**48** 362, 549] (including its form *nigrum* Gir. [**26** 744]), *T. minutissimum* Pack. [**26** 744], *T. cuproctidis* Gir. [**22** 597] and *T. pallidum* Meĭer [**30** 298] (which was treated as a form of *T. cacoeciae* by Telenga [**48** 362]). *T. koehleri* Blanch., which has been recorded from Argentina [**33** 117] but of which the original description and habits were not known to the author, may be a synonym of *T. minutum*, and *T. luteum* Gir., which occurs in parts of Africa, is probably referable to the genus *Trichogrammatoidea*.

European and Mediterranean Plant Protection Organisation. **Colorado beetle in Europe in 1960.** [*In English & French.*]—[3 +] 18 + xvii pp., 1 map, 2 refs., multigraph. Paris, 1961.

The occurrence and distribution of *Leptinotarsa decemlineata* (Say) on potato in Europe in 1960 are surveyed as for previous years [*cf. R.A.E.*, A

48 400, etc.], and the distribution is illustrated on a map. Although abnormally hot and dry weather occurred early in the year, conditions generally were not particularly favourable for the beetle; nevertheless, in spite of continued control activity, it extended its range further to the east. New areas were infested in the Soviet Union, Poland, Yugoslavia and Czechoslovakia; the last of these countries is now totally infested, as also are Hungary and Rumania. Besides the continued eastward spread, there was evidence of a northward movement into Denmark and a southward trend in Italy and in Bulgaria, in which country tobacco crops have been seriously damaged. Notes on control are included, and resistance to DDT and other chlorinated-hydrocarbon insecticides is reported from Portugal, Spain, Italy, Switzerland, Austria and Poland.

European and Mediterranean Plant Protection Organisation. **San José scale in Europe and the Mediterranean Basin in 1960.** [*In English & French.*]—[3 +] 16 + xvi pp., 2 refs., multigraph. Paris, 1961.

The distribution and occurrence of *Quadraspidiotus perniciosus* (Comst.) in Europe and Algeria in 1960 are reviewed as for earlier years [*cf. R.A.E.*, A **49** 47, etc.]. The scale spread slightly in five of the countries already infested, but appeared in no fresh ones.

European and Mediterranean Plant Protection Organisation. **Report of the Working Party on Fumigation Standards (London, 7–10 February 1961).** [*In English & French.*]—39 pp., 4 refs. Paris, 1961.

This working party on fumigation standards had as its object to discuss the basic principles of fumigation as applied to plants and plant parts with a view to the formulation of standards that could be recommended for international adoption. Much of this report of its work is concerned with the utility of concentration-time products in fumigation studies, and recommendations for their use in fumigation schedules are made. Four introductory papers read are given in both languages in appendices. These are: The scientific principles of fumigation, by H. A. U. Monro; The need for uniformity in the description of gas treatments and the requirements they should meet, by A. B. P. Page; Specific problems related to the properties of the fumigation chamber. The influences of packing materials and soil, by P. H. van de Pol; and Equipment employed for fumigation with different fumigants, both in chambers and under gasproof sheets. Minimum requirements for sheets and chambers, by A. B. P. Page.

Orian (A. J. E.) & Moutia (L. A.). **Fruit flies (Trypetidae) of economic importance in Mauritius.**—*Rev. agric. sucr. Maurice* **39** no. 3 pp. 142–150, 2 pls., 4 fldg. tables, 9 refs. Port Louis, 1960.

Recent surveys in Mauritius have shown that, in addition to the six Trypetids of economic importance recorded in 1942 [*R.A.E.*, A **32** 338], two other species, *Ceratitis rosa* Karsch and *Pardalaspis cyanescens* Bez., are now present.

C. rosa (Natal fruit-fly) is believed to have been introduced about 1953 in fruits brought by passengers from South Africa. It attacks many fruits in Mauritius, those infested in different months being shown in a table, but not the wild *Solanum auriculatum*, which is common there and harbours the fly in spring in South Africa [*cf.* **19** 252]. Favourable weather enabled it to become established and to increase very greatly in numbers. Since 1955, it has largely replaced *C. capitata* (Wied.), which now occurs only sometimes

in ripe chillies [*Capsicum*] and more rarely in the fruits of guava, peach and corinda (*Carissa carandas*). Observations on the bionomics of *C. rosa* showed that it has 10–12 generations a year. The female lays eggs in batches of 10–20 just below the skin of the fruit, making up to 20 punctures per fruit. At temperatures of 25–28°C. [77–82·4°F.], the egg, larval, prepupal and pupal stages average 4, 10·5, 1·5 and 11·5 days, respectively, and pupation occurs in the soil. The adults survive for an average of 56 days when raisins, hydrolysed yeast and water are provided.

P. cyanescens is probably indigenous in Madagascar, where it infests tomatos and wild solanaceous plants but is not a major pest, being attacked by various parasites and predators, including a Braconid, *Opius insignipennis* Granger, which was reared from the pupae. *P. cyanescens* also infests tomato in Réunion. In Mauritius, it was first observed in October 1958, when losses of tomatos near Port Louis were heavy, and is extending its range to the uplands. No wild plants have so far been attacked, though *S. auriculatum* is its main secondary host-fruit in Madagascar. Observations on its bionomics showed that development lasts 22–32 days. The female lays 40–100 or more eggs, making 2–12 punctures per fruit. At 29°C. [84·2°F.], the larvae hatch in three days and burrow in the fruit, where they remain for 10–15 days; 2–10 larvae per fruit become full-fed. The pupal stage is passed in the soil and lasts ten days, and the adults live for up to several weeks when fed on dried raisins.

The only other species of importance on fruits is *Ceratitis catoirii* Guér., which is restricted to Mauritius and Réunion and is controlled in the former by a species of *Opius*, apparently *O. insignipennis*, its only known parasite there.

Cucurbits are attacked by *Dacus ciliatus* Lw., *D. d'emmerezi* Bez., *D. zonatus* (Saund.) and *D. cucurbitae* Coq. The last occasionally infests mangos, and is being replaced on *Terminalia catappa* by *C. rosa*. Attack by *Dacus* spp. is sporadic, with no well-marked seasonal distribution of species. The durations of development of *D. ciliatus* and *D. d'emmerezi* in summer and winter and of *D. cucurbitae* in the laboratory are shown in a table. The first two produce 15–18 generations a year, and their life-cycles are similar.

A table showing the plants attacked by the eight species is included, together with figures for the identification of all except *D. zonatus*, which is generally very scarce.

Scattered fruit trees are perpetual sources of infestation and increase the difficulty of systematic control, but for partial protection of orchards against *Ceratitis* spp., early spraying is recommended with ethyl-DDD (Perthane), DDD (Rhothane), DDT, malathion, sodium fluosilicate or trichlorphon (Dipterex), followed by weekly treatment with bait-sprays of 10 per cent. sugar solution containing trichlorphon, sodium fluosilicate or malathion at 0·6, 0·3 or 0·5 per cent. toxicant, respectively. For partial control of *Dacus* spp. on cucurbits, maize should be sown in two rows 6 ft. apart round plantings and sprayed in the afternoon with a mixture of 5 per cent. sugar solution and lead arsenate, DDT, γ BHC (Gammexane) or aldrin at 0·15, 0·02, 0·3 or 0·1 per cent. toxicant, respectively. Against *P. cyanescens*, a spray of 0·5 per cent. wettable trichlorphon, applied weekly, and a bait-spray of 0·6 per cent. trichlorphon and 10 per cent. sugar reduced infestation from 86 to 10 per cent. Other than the species of *Opius* attacking *C. catoirii*, the only local parasite of Trypetids recorded in Mauritius is *Eucoila* sp., which attacks *C. capitata*; 11 other species were imported in 1935–49 and 1957–59, of which two, *O. oophilus* Fullaway and *Syntomosphyrum indicum* Silv., introduced from Hawaii in 1957–59, were recovered from *Ceratitis* spp.

Rao (V. P.) & Krishnaswamy (S.). *Melcha ornatipennis*: **its occurrence in south India and a method for its laboratory multiplication.**—*FAO Plant Prot. Bull.* **9** no. 5 pp. 69–73, 3 figs., 8 refs. Rome, 1961.

Goryphus (*Melcha*) *ornatipennis* (Cam.), which was described from Burma, parasitises the top borer, *Scirpophaga nivella* (F.), on sugar-cane in many parts of India [*cf. R.A.E.*, A **36** 119, etc.]. It is a potential parasite of species of *Scirpophaga* in other countries, and also of stem borers of the genus *Diatraea*, since it was found experimentally to attack *D. saccharalis* (F.) in the West Indies, though not *Diatraea* spp. in Mexico. With a view to facilitating its future use, the authors developed a method of breeding it in large numbers in the laboratory on larvae of *S. nivella* and describe the techniques used. The females failed to oviposit on larvae of *Corcyra cephalonica* (Stnt.) or *Gnorimoschema operculella* (Zell.), on sugar-cane stem borers such as *Chilotraea infuscatella* (Sn.) and *Proceras indicus* Kapur, or on the sorghum stem borer, *Chilo zonellus* (Swinh.), but the larvae fed readily when eggs were placed on pupae of these species. As the larvae and pupae of *Corcyra cephalonica* are small, more than one must be used per parasite. When larvae of alternative hosts were used, they had to be parasitised by *Bracon* (*Microbracon*) *hebetor* Say or *B.* (*M.*) *brevicornis* Wesm. before the parasite eggs were transferred to them. Alternative hosts can thus be used for breeding, provided that a few larvae or pupae of *S. nivella* are present to induce oviposition.

Castillo (B. S.) & Martinez (A. L.). **Occurrence of bunchy top disease of banana in the Philippines.**—*FAO Plant Prot. Bull.* **9** no. 5 pp. 74–75, 3 figs., 4 refs. Rome, 1961.

Bunchy top, which occurs on abacá (*Musa textilis*) in the Philippines [*cf. R.A.E.*, A **39** 64] and has *Pentalonia nigronervosa* Coquerel as its only vector, was observed on banana there for the first time in May 1960. The symptoms caused by the virus are described and positive transmission tests with the aphid reported.

Peretz (I.) & Cohen (M.). *Apate monachus* **in Israel.**—*FAO Plant Prot. Bull.* **9** no. 5 pp. 76–79, 4 figs., 8 refs. Rome, 1961.

Apate monacha F., which is known mainly from Africa, damaged *Citrus* trees in the coastal plain of Israel in 1930. An outbreak of the Bostrychid began there in 1950, and the beetle has since spread to almost all parts of the country, attacking fruit trees in the mountains as well as in the coastal area. Observations made in 1955–60 showed that it attacks trees of over 40 species, including many fruits. In a mixed orchard, carob (*Ceratonia siliqua*) is chiefly infested early in the season and olive and vines in late August. Damage is caused only by the adults, which bore in the bark and wood of the branches and trunks, forming tunnels some 4–8 in. long. Growth is arrested, and severe infestation kills the tree. A beetle bores several tunnels, each being completed in about 8–10 days, and 300–500 tunnels containing 50–70 living beetles may occur on a single heavily infested tree. On olive, the tunnels are mostly in the upper branches. The beetles appear in May, or, in the cooler mountain areas, in April, are most numerous in July–August, and persist until November. They shelter in the tunnels by day and move over the trees by night, ovipositing in crevices in dried branches or dried cut wood, but never in living trees. Eggs are laid from the end of May onwards, up to 125 being laid per female, with an average of 77. The

larvae hatch in 5–6 days in summer and 8–9 in autumn, and enter the dead wood. They pupate in their tunnels after April, and pupae are present in spring, summer and early autumn. In spring, the pupal stage lasts 15–18 days. The newly emerged adults gnaw their way out, the process taking 5–15 days. Details of the life-cycle at different seasons in field cages are shown in a table. Natural mortality of larvae and pupae was high, though natural enemies were not observed. The larvae are attacked by larvae of *Leucospis dorsigera* F., which hatch from eggs laid on dry branches near tunnels containing *Apate* larvae, but do not seem to be common.

Control of *A. monacha* is difficult. Field sanitation is recommended. Tests showed that the adults are susceptible to BHC and dieldrin, and treatment of carob and vines in the summer of 1959 with a 20 per cent. BHC dust, applied seven times at intervals of 15 days, prevented the entry of adults. In 1960, equally good results were obtained with three applications at monthly intervals, from 1st July to 1st September. Treatment of the trunk and lower branches sufficed to prevent damage.

Recommended analytical methods for pesticides. 2. Determination of sulphur in colloidal sulphur. 3. Determination of sulphur in dispersible sulphur. 4. Determination of particle size distribution in colloidal and dispersible sulphurs.—*FAO Plant Prot. Bull.* **9** no. 5 pp. 80–84, 1 fig. Rome, 1961.

The three analytical methods described were accepted in June 1960 by the Collaborative Pesticides Analytical Committee [*cf. R.A.E.*, A **49** 267].

Outbreaks and new records.—*FAO Plant Prot. Bull.* **9** no. 5 pp.85–86, 2 refs. Rome, 1961.

It is reported from Jamaica by G. Stell (p. 85) that the tristeza virus has been found on grafted *Citrus* there. Its behaviour resembled that of the mild strain of the virus occurring in Florida [*cf. R.A.E.*, A **47** 60], its incidence is low, and spread by insects is slight. The only insect vector so far found in the island is *Aphis gossypii* Glov., which is not an efficient disseminator of the virus. Quarantine measures to prevent the entry of a more virulent virus strain and of *Toxoptera citricidus* (Kirk.), a more efficient vector, are being strictly enforced, and susceptible rootstocks are being replaced by resistant or tolerant ones.

G. H. Berg reports from Nicaragua (pp. 85–86) that a few examples of *Chloriona* (*Sogata*) *orizicola* (Muir) were found in 1961 among a collection of Homoptera from a variety of rice resistant to the hoja blanca disease about 20 miles east of Managua. This Delphacid transmits the virus that causes the disease [*cf.* **47** 31], but the disease itself is unknown in Nicaragua.

M. A. Ghani (p. 86) states that, despite the wide distribution of *Ostrinia* (*Pyrausta*) *nubilalis* (Hb.) throughout the world, including India, the only published reference to its occurrence in Pakistan is contained in a map of its world distribution [**40** 203], which includes a record from West Pakistan based on a specimen in the British Museum (Natural History) that was collected in the West Punjab in 1909. In the course of examination of weeds in the Murree Hills, near Rawalpindi, in June 1959, larvae of *O. nubilalis* were observed on *Cnicus wallichii*, a thistle that is common at altitudes above 4,000 ft. Infestation was heavy and parasitism low. In 1960, the insect was found on the same weed in Kashmir and the Gilgit Agency. Although maize was growing close to the weed throughout the Murree Hills, it was not infested.

MacCuaig (R. D.). **Spray-collecting area of locusts and their susceptibility to insecticides.**—*Nature* **182** no. 4633 pp. 478–479, 5 refs. London, 1958.

The spray-collecting area of a locust is fundamental to the interpretation of techniques that have been developed for the estimation of the amount of spray collected by individual locusts [*cf. R.A.E.*, A **37** 134; **38** 480]. The areas used are, for settled locusts, the plan area, reduced to allow for the less vulnerable parts, and, for flying locusts, the ' horizontal equivalent area ' [**42** 125]. For *Schistocerca gregaria* (Forsk.), the plan area is about 6·5 sq. cm. and the horizontal equivalent area varies with droplet size [**42** 125]. The collecting surface of a settled locust approximates to the plan area when the drops are falling nearly vertically, but at shallow angles the quantity of spray falling on the locust is many times more than that estimated from area dosage and plan area. These parameters can be related by consideration of the ' normal equivalent area ', or area of a plane surface at right angles to the path of approach of the drops (which depends on their terminal velocity and the air speed of, or wind speed over, the locust), through which pass as many drops as are collected by the locust under similar conditions. This area is most easily measured in the laboratory by comparing the quantity of spray picked up by a locust with that deposited on a sphere under similar conditions. In experiments with settled locusts free to orientate, the mean horizontal equivalent area was 5–6 sq. cm. for uniform sprays of drops 50, 100 or 230 μ in diameter passing over them at 2 m. per second; at lower wind speeds, it was less. For locusts flying through a falling spray, the normal equivalent area was about 9 sq. cm. for males and 10·5 sq. cm. for females, and it was virtually independent of droplet diameter over the range 50–230 μ. Since the volume of a uniform spray picked up by a locust is equivalent to the product of the normal equivalent area, the spray concentration and the path-length through the spray and since, in consequence, the relative quantity of sprays of similar concentrations at similar relative wind speeds deposited on flying and settled locusts is proportional to their normal equivalent areas, flying locusts receive almost twice as much as settled ones. Furthermore, the deposit on a settled locust can be expected to exceed the corresponding area dosage on a horizontal surface by a factor approximating to the cosecant of the angle of approach of the spray, measured from the horizontal. When flying and settled locusts were sprayed with a 20 per cent. solution of DNC in oil, the LD50's fell from 30 to 16 μg. per g. [*cf.* **42** 125] and from 35 to 25 μg. per g., respectively, as the diameter of the droplets decreased from 300 to 100 μ. The toxicity of diazinon to flying locusts showed little change with droplet diameter. If the differences in collecting area and susceptibility are combined, flying locusts are about 2·4 times as vulnerable to DNC and about twice as vulnerable to diazinon in sprays as settled ones. The difference in vulnerability is increased in the field, since the wind gradient near the ground effectively reduces the path-length of the settled locusts through the spray and may also reduce their normal equivalent areas. In field operations with aircraft, however, the greater vulnerability of flying locusts is at times more than counterbalanced by their low density.

Wayman (C.). **Note of the occurrence of** *Cryptophagus subfumatus* **Kraatz (Col., Cryptophagidae) on Californian seedless raisins.**—*Ent. mon. Mag.* **93** no. 1112 pp. 11–12, 3 refs. London, 1957.

Californian seedless raisins that had been in store for 20 months in cardboard cartons stacked, generally 12–14 ft. high, in warehouses in north-eastern England were found during the winter of 1954–55 to be heavily infested by

Cryptophagus subfumatus Kraatz [*cf. R.A.E.*, A **32** 435; **48** 168], which is seldom injurious in Britain. Before being stored, the cartons had received several handlings, including fumigation, during which many of them were damaged. The fruit remained in good condition for a year, but the pressure exerted in the stack later caused the juice to run out, the cartons became wet, and the raisins began to ferment. Large numbers of adults and larvae of *C. subfumatus* were found in the fermenting raisins, which in some cases were reduced to a powdery mass. Adults of *C. pseudodentatus* Bruce were also found in one warehouse. The deterioration is attributed in part to the length of storage and the damage to the cartons, but chiefly to compression due to the height of the stacks, since raisins in stacks of only eight cartons were undamaged. The Braconid, *Blacus instabilis* Ruthe, was found on the raisins in two warehouses. This parasite usually attacks Lathridiids, and *Lathridius* (*Enicmus*) *minutus* (L.) was present in both warehouses, but in such small numbers that *C. subfumatus* was probably also being attacked.

Legowski (T. J.) & Gould (H. J.). **Experiments on the control of frit fly, *Oscinella frit* (L.), on late-sown oats with seed dressings and 'late' sprays.**—*Bull. ent. Res.* **52** pt. 3 pp. 443–455, 1 pl., 10 refs. London, 1961.

The following is largely the authors' summary. In plot trials in 1954–59 with seed dressings on late-sown oats for the prevention of shoot attack by *Oscinella frit* (L.) in eastern England, γ BHC, parathion, dieldrin, heptachlor, dimethoate (Rogor) and Telodrin (1,3,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanophthalan), the last used both wet and dry, reduced the attack, but the effect was variable and mostly not appreciable. In 1952 and 1956–60, trials were made of the effect of late sprays of various insecticides applied to late-sown oats when symptoms of attack by *O. frit* were already conspicuous and sometimes severe. An advantage of this type of treatment is that it ensures that insecticides are applied only where and when necessary. Single sprays of parathion, dieldrin, γ BHC and dimethoate prevented or markedly reduced further attack, and they were most effective when applied within about 15 days of the beginning of egg-laying and when plants were in the young seedling stage. Compared with the best treatment (two early preventive sprays of DDT), there was only a slight reduction in yield. Parathion and, to lesser extent, γ BHC killed many larvae inside the shoots and probably prevented others from entering them.

Blake (G. M.). **Length of life, fecundity and the oviposition cycle in *Anthrenus verbasci* (L.) (Col., Dermestidae) as affected by adult diet.**—*Bull. ent. Res.* **52** pt. 3 pp. 459–472, 1 pl., 2 graphs, 19 refs. London, 1961.

The following is based on the author's summary. A study was made of length of adult life, fecundity and oviposition in *Anthrenus verbasci* (L.) and the effects on them of adult nutrition. The duration of inactive (unmated) life for males and females at 20°C. [68°F.] and 70 per cent. relative humidity was 7·5 and 7·7 days, respectively. This period, which is spent in the moulted last larval skin, decreased with rise in temperature, from a mean of 32·4 days at 10°C. [50°F.] to 3·8 days at 25°C. [77°F.]. Differences in humidity had relatively little effect. The effects of various diets on the length of life, oviposition cycle and fecundity of active adults were observed. The experimental diets were water or sugar solution (equal parts of glucose, sucrose and fructose in water), each used alone and with the addition of

pollen or albumen. The control group was deprived of both food and water. There were no differences in length of life between beetles given the water diets and the control beetles, the range being 18·2–20·9 days for males and 22·1–26·1 for females, but there was an increase for both sexes in beetles given sugar solution and a further increase, to a mean of 58·3 days for males and 69·5 for females at 20°C. and 70–90 per cent. relative humidity, when albumen was added to the sugar solution. A diet of sugar solution with pollen increased still further the life-span of males, but not that of females, which was the same as on a diet of sugar solution alone. The preoviposition period ranged from three to 14 days, with a mode about the fourth day. The oviposition cycle consisted of three clearly defined peaks on about the 6th, 12th and 17th days. There was a similar pattern in all the groups, except that those given sugar solution continued to lay, at a low rate, after the end of the third peak. The average number of eggs laid per female when deprived of food and water was 50·3; for females given the water diets there was a significant decrease, and for those given sugar solution there was an increase that became significant when pollen or albumen was added. Maximum fecundity was attained on a diet of sugar solution with albumen. There was significant correlation between length of life and weight on emergence for males given the water diets and for females given water with pollen or albumen. There was significant correlation between fecundity and emergence weight both for females given water alone or with pollen and for the control females.

Loan (C.) & Holdaway (F. G.). *Pygostolus falcatus* (**Nees**) (**Hymenoptera, Braconidae**), **a parasite of** *Sitona* **species** (**Coleoptera, Curculionidae**).—*Bull. ent. Res.* **52** pt. 3 pp. 473–488, 4 figs., 17 refs. London, 1961.

Work on the introduction of insect parasites into Canada for the control of *Sitona cylindricollis* Fhs. on sweet clover [*Melilotus*] was begun in 1952, and three Braconids were released, of which one was *Pygostolus falcatus* (Nees) [*cf. R.A.E.*, A **17** 435; **24** 453]. The bionomics of this parasite, all stages of which are described, were studied in the laboratory at 74°F. and in field cages at Belleville, Ontario, in 1956–59 from material reared from *S. lineatus* (L.), *S. hispidulus* (F.) and *S. humeralis* Steph. from Sweden, and the following is based almost entirely on the authors' summary of the results. Several species of *Sitona*, including *S. cylindricollis*, were parasitised. The immature stages occur in the haemocoele of the adult weevil. Supernumerary larvae are eliminated soon after hatching, and only one parasite develops in each host. At 74°F., the last-instar larva emerges from the host 15–16 days after deposition of the egg. Many first-instar larvae developing in *Sitona* spp. entered diapause, and those that did so in overwintered weevils were eliminated by the natural death of the host. The presence of a parasite egg or first-instar larva in a host female prevents the latter from ovipositing, and the host dies a few hours after the parasite larva has emerged from it. Reproduction by *P. falcatus* is parthenogenetic and thelytokous. The maximum number of eggs laid by a female was 46; the number laid per day per female varied from 0 to 11, and ovipositing females showed no preference for any of four species of *Sitona*, including *S. cylindricollis*, in the laboratory. The maximum number of weevils in which eggs were laid by a female in a field cage was 39; the number attacked per day varied from 0 to eight. *P. falcatus* overwinters as a first-instar larva in hosts that became adult in the previous summer. There were two discrete parasite generations in 1958 in weevils forwarded from Sweden, and both developed in early summer and midsummer within overwintered weevils. The maximum

rate of parasitism of *S. lineatus* by larvae of the midsummer generation in 1958 was 73·3 per cent. *P. falcatus* was released in Manitoba in 1958, and immature stages were recovered from *S. cylindricollis* in the release area in 1959 and 1960. The value of this parasite as a control agent is limited by its low degree of attack on the generation of the current year and by the diapause of the first-instar larvae.

Nye (I. W. B.). **Report on the control of** *Melittomma insulare* **Fairm. (Coleoptera, Lymexylonidae) attacking coconut palms in Seychelles.**—[2 +] 64 pp., 1 fig., 2 maps (1 col.), 7 refs., multigraph. [Mahé] 1959. **Second report on the control of** *Melittomma insulare* **(Coleoptera, Lymexylidae) and other pests attacking coconut palms in Seychelles.**—[14] pp., 4 refs., multigraph. [London, Colon. Off.] 1961. **The control of the coconut pest** *Melittomma insulare* **(Coleoptera, Lymexylidae) in Seychelles.**—*Bull. ent. Res.* **52** pt. 3 pp. 489–499, 1 fig., 6 refs. London, 1961.

The third of these papers on the control of *Melittomma insulare* Fairm. on coconut in the Seychelles is based on the considerably more detailed accounts contained in the first two, and the following is substantially the author's summary of it. The larvae of *M. insulare* bore into the bases of coconut palms, and associated with them are micro-organisms that cause extensive rotting of the boles, particularly at ground-level, which results in the palms falling [*cf. R.A.E.*, A **42** 120–121, etc.]. During 1953–58, an attempt was made in Praslin Island to obtain maximum control of this pest by using p-dichlorobenzene as a fumigant [*cf.* **42** 121]. At the time of the treatment, 77 per cent. of the 90,500 coconut palms in the island were infested. Of these, about 5 per cent. were felled as worthless mountain-side palms and 9 per cent. fell during or within a week of treatment. In 1960, it was found that a further 15 per cent. of the palms had fallen and that 53 per cent. of those still standing remained infested. The continuing high loss of palms after treatment was due to the closed, moist fumigation chambers within the trunks, which encouraged the spread of rot, coupled with an incomplete kill of larvae. A new method of treatment is described in which the necrotic wood is excised and a formulation of coal-tar creosote and coal tar liberally applied. Praslin Island was re-treated, by this method, and treatment of all the coconut palms in Mahé, the main island of the group, was subsequently begun. Losses of palms during and within a week of treatment were reduced to less than 1 per cent., and results are cited, showing that a single treatment can reduce a serious infestation in which 80 per cent. of the palms are more or less heavily attacked to one in which only 18 per cent. are attacked and, on average, contain only five larvae each. The treatment ensures that the entrances to the tunnels of these are exposed to view, so that the surviving larvae can easily be killed.

Robertson (P. L.). **A revision of the genus** *Tyrophagus*, **with a discussion on its taxonomic position in the Acarina.**—*Aust. J. Zool.* **7** no. 2 pp. 146–181, 41 figs., 3½ pp. refs. Melbourne, 1959. **A morphological study of variation in** *Tyrophagus* **(Acarina), with particular reference to populations infesting cheese.**—*Bull. ent. Res.* **52** pt. 3 pp. 501–529, 25 figs., 41 refs. London, 1961.

The revision of the genus *Tyrophagus* that is the subject of the first paper was undertaken to stabilise the names of common economic species, find

means for compensating for the absence of type material and re-assess the characters used for species separation. It is based on Oudemans' collection, museum specimens in various countries and an extensive series of mounts prepared from fresh material, and contains much new synonymy. A key to the 11 species recognised is given, together with information varying in scope, but usually including male dimensions, habitat and distribution, relating to the individual species.

Oudemans designated *Acarus putrescentiae* Schr. as the type species of *Tyrophagus*, but this species has been considered unrecognisable [*cf. R.A.E.*, A **31** 69] and it has been inferred that Oudemans' concept of it was confused. Schrank's description contains little that is definitive, but Oudemans in 1902 found examples in the habitat (under rotten leaves on damp humus) given by Schrank, and examination of his specimens labelled *T. putrescentiae*, which were collected over a period of 30 years, showed that most of them, and all those collected in 1924 when he erected *Tyrophagus*, belong in fact to one species. This species is therefore accepted as the true *T. putrescentiae* and, since Schrank's material is lost, a male in Oudemans' collection dated 1902 is designated as the neotype, which is described. The synonyms of *T. putrescentiae* include *Tyroglyphus lintneri* Osb. [**26** 286; **31** 157], *T. americanus* Banks [**39** 153], *T. muscae* Sasaki [**12** 350; **16** 300], *T. nadinus* Lombardini [**36** 114], *Tyrophagus castellanii* (Hirst) [**25** 707; **48** 135], *T. noxius* Zkhv. [**31** 380, etc.] and *T. bülleri* Voloshchuk [**25** 134]. *T. putrescentiae* is known from an extremely wide range of habitats, including growing plants, fruit, seeds, grain, plant and animal products, decaying plant matter, insect cultures, dead insects, buildings and débris, in addition to cheese, and occurs in England, Holland, Denmark, Germany, New Zealand, New South Wales, Canada, the United States, Mexico and Indonesia.

Among the other species recognised, *T. australasiae* (Oudm.) from New Guinea [*cf.* **5** 273] is so closely related to *T. putrescentiae* that it may be a subspecies of it. Lectotypes are designated for it and for *T. palmarum* (Oudm.) [*cf.* **49** 158], of which the synonyms include *T. parvulus* Volgin [**39** 417]. *T. palmarum* is known from the rotting stem of an indoor palm in Holland, cheese in various countries and sultanas, ham and hay in England. Three new species are described, *T. brevicrinatus* from copra in Ghana, *T. tropicus* from tobacco in New Britain, palm-kernel dust in Nigeria, copra in Zanzibar and native-cleaned rice in Ghana, and *T. oudemansi*, which is recorded damaging seedling rye and barley in Germany, and is also known from tomato seedlings in Holland, straw in a plant nursery in New South Wales, plants and soil in New Zealand and mushrooms, seedlings and the soil of an insect culture in England. *T. oudemansi* was misidentified as *Tyroglyphus dimidiatus* (Herm.) (*longior* Gerv.) by Jary & Stapley [**25** 706] and van den Bruel [**34** 161] and as *Tyrophagus humerosus* (Oudm.) by Zakhvatkin [**31** 69]. *T. perniciosus* Zkhv., the male of which is redescribed from a typical specimen, is known from oats and barley in the field and from granaries and storehouses in the Soviet Union, from damaged cheese in England and in dirty seed in a bird cage in South Australia, and *T. molitor* Zkhv., of which the female is unknown, is recorded from refuse in a flour mill in the Soviet Union.

There has been much confusion regarding the species called *Tyrophagus dimidiatus* by Oudemans, and in Britain the name has been applied to at least three species. These are a mite infesting stored products referable to *T. palmarum* or *T. putrescentiae*, the field species of Jary & Stapley already mentioned, referable to *T. oudemansi*, and a mite identified by Hughes first as *T. tenuiclavus* Zkhv. and subsequently as *T. dimidiatus*. From the

morphological characters and habitat given by Hermann, his species is either unrecognisable or not referable to *Tyrophagus*, and it has been proposed to the International Commission that *T. dimidiatus* should be rejected as a *nomen dubium* and *T. longior* (Gerv.), the next available name, adopted in its place. Gervais' description of *T. longior* and a plate published by Fumouze & Robin clearly represent the species called *dimidiatus* in error by Oudemans in 1924 and prior to that known as *longior*. Since the type material of *T. longior* and the material of Fumouze & Robin is lost, a male taken from cheese in Holland in 1954 is designated as the neotype and, with a female from the same population, is described. The synonyms of *T. longior* include *T. tenuiclavus* [*cf.* **41** 53; **49** 158], *Tyroglyphus infestans* Berl. [**15** 109; **31** 157] and *T. humerosus* Oudm. The species is known from plant tissues in Denmark, Holland, England and New Zealand, grain, grain débris and grass seed in the last three countries and Canada, cheese in Germany, New Zealand [*cf.* **37** 448], Australia and England, ham in England, a house in Italy, and other miscellaneous habitats. The status of a further 13 species, which are listed, is uncertain. They include *Tyrophagus breviceps* (Banks) [**45** 194], *T. similis* Volgin [**39** 417] and (*Tyroglyphus*) *sacchari* (Banks) [**5** 314].

The second paper contains an account of investigations on variation in populations of *Tyrophagus*, especially those in cheese, carried out with material from Britain, New Zealand, Australia, Holland and the United States, and the following is based mainly on the author's summary of it. The difficulty of deciding the systematic status of variations within and between populations of *Tyrophagus* is considered in relation to the wide distribution of the genus and the many materials infested. Variation within populations of what was thought to be one species infesting cheese is explained by the isolation of three closely similar forms that are difficult, if not impossible, to separate by measurement alone. Frequency distributions overlap slightly for four linear measurement ratios on which separation was attempted, but differences between them are emphasised by differences in minute structural characters and they are therefore accepted as distinct species, identified as *T. longior*, *T. palmarum* and *T. putrescentiae*, respectively. Variation between populations attacking plant materials and other stored products in addition to cheese is accounted for to some extent by the recognition of three further species, *T. oudemansi*, *T. brevicrinatus* and *T. tropicus*. Within the species recognised, significant differences are recorded in dorsal hair characters and body proportions between populations on cheese produced in different geographical areas, and also between cheese populations and those infesting other materials, and these differences are thought to be at a racial level. *T. longior*, *T. palmarum* and *T. putrescentiae* are distributed round the world, but as cheese pests they occupy somewhat different, although overlapping, geographical zones, since *T. longior* is a form of temperate or cool areas, *T. palmarum* a temperate form and *T. putrescentiae* a subtropical or tropical form. The three are also found to occupy different, but overlapping, ecological zones, making possible their association in mixed populations. Confusion in ecological data previously published on *Tyrophagus* is thought to be attributable in part to similarities in the morphology, geographical distribution and ecology of its species and to their close association.

The results suggest that *Tyrophagus* spp. are the most important mites infesting stored products in Australia and New Zealand, that in Britain they share first place with the grain mite, *Acarus siro* L. (*Tyroglyphus farinae* (L.) Deg.), which is favoured there by conditions of high humidity in storage, and that they may well prove to be common in the tropics.

Kalra (A. N.) & Kulshreshtha (J. P.). **Studies on the biology and control of** *Lachnosterna consanguinea* **(Blanch.), a pest of sugarcane in Bihar (India).**—*Bull. ent. Res.* **52** pt. 3 pp. 577–587, 4 figs., 7 refs. London, 1961.

The following is based largely on part of the authors' summary of this account of investigations on *Lachnosterna consanguinea* (Blanch.) attacking sugar-cane in the Dalmianagar area of Bihar, some of the information in which resembles that already noticed [*R.A.E.*, A **47** 77]. The adults are not known to be injurious, but the larvae are very destructive to cane in the area where they were first recorded and have also occurred in serious numbers in some adjoining areas. In severe infestations, as much as 80 per cent. of the crop is lost. Infestations occur only on light, sandy soils; crops on clay soils are not affected [but *cf. loc. cit.*]. The eggs are laid in the soil at depths of about 2–4 in. and hatch in 8–10 days. The larvae move to cane roots after some initial feeding on grass roots, become fully grown in 8–10 weeks and pupate in earthen cells at depths of about 1–5 ft. The pupal stage lasts 12–16 days, and winter is passed in the adult stage.

The adults can be destroyed in large numbers by means of light-traps, but it is easier and more effective to collect them at night from trees and shrubs. Trials with sprays applied to the foliage of shrubs in cages into which adults were immediately introduced showed that a suspension of 0·5 per cent. DDT was effective and superior to one of BHC. In replicated field trials on the control of the larvae, BHC applied to the soil in a dust at the rate of 22·4 lb. toxicant per acre was more effective than aldrin, dieldrin, chlordane or heptachlor. This treatment when applied at planting time, in February, had an adverse effect on germination, which was not observed when treatment was applied at the end of May. In subsequent replicated experiments, BHC at 10 lb. per acre as a dust applied during large-scale adult emergence at the end of May, and again in July, gave much better results, with no adverse effect on the crop. BHC, DDT and heptachlor applied to the soil in sprays at 10 lb. per acre at the end of May were ineffective. Two of 11 varieties of cane showed greater tolerance of larval injury than the others.

Scolia aureipennis Lep. parasitised the larvae during September, but the rate of parasitism was only about 5 per cent. A disease caused by a fungus, *Metarrhizium anisopliae*, was observed in the adults. Affected beetles died within 4–6 days. Toads and geckos were seen preying on the adults in the evening, and various birds fed on the larvae exposed during tillage operations.

Winfield (A. L.). **Observations on the biology and control of the cabbage stem weevil,** *Ceutorhynchus quadridens* **(Panz.), on Trowse mustard (***Brassica juncea***).**—*Bull. ent. Res.* **52** pt. 3 pp. 589–600, 1 graph, 10 refs. London, 1961.

The following is based on the author's summary. In 1958–60, replicated insecticide trials were carried out on Trowse mustard (*Brassica juncea*) in eastern England in an attempt to assess seed losses caused by larvae of *Ceutorhynchus quadridens* (Panz.) [*cf. R.A.E.*, A **45** 452]. The over-wintered adults invade the young growing crops in April and May, and the eggs are laid in the petioles over a period of weeks, depending on temperature and crop stage, until about mid-June. Egg-laying began on mustard when the plants had produced 6–7 broad leaves, but the actual time at which the first eggs were laid seemed to depend mainly on temperatures during May. In the insecticide trials, infestations averaged up to 26 larvae per plant, and none of the untreated plants escaped attack. In tests with seed dressings,

γ BHC at high rates (5 or 10 per cent. of the weight of the seed) gave some control of the larvae when the adhesive used was kerosene, but not when it was methyl cellulose [*cf.* **49** 257]; 3 or 5 per cent. phorate and 5 per cent. Telodrin (1,3,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanophthalan) gave no control. The control by seed dressing was unreliable and is considered unsuitable for assessing yield losses caused by *C. quadridens*. A single emulsion spray of dieldrin applied during May, when the first feeding holes made by the adults were found in the petioles, gave good control and prevented egg-laying, and this treatment seems promising for work on damage assessment. Sprays specifically directed against *C. quadridens* would seldom be justified economically on commercial crops of mustard, but on April-sown crops the first dieldrin spray applied against *Meligethes aeneus* (F.) may give some protection against the weevil. The experiments gave no reliable indication of the effects of *C. quadridens* on seed yields, in spite of their being sited in localities known to have a high weevil population. It was clear, however, that sowing date greatly influenced yields; plants sown in March outyielded those sown in April or early May.

Gough (H. C.), Woods (A.), Maskell (F. E.) & Towler (M. J.). **Field experiments on the control of wheat bulb fly,** *Leptohylemyia coarctata* **(Fall.).**—*Bull. ent. Res.* **52** pt. 3 pp. 621–634, 12 refs. London, 1961.

The following is based on the authors' summary. Seed dressings of γ BHC, aldrin, dieldrin, endrin, DDT and parathion were tested in field experiments for the control of *Hylemyia* (*Leptohylemyia*) *coarctata* (Fall.) on wheat in eastern England in 1951–60 [*cf. R.A.E.*, A **44** 260]. The concentrations ranged from 20 to 70 per cent., and the dressings were applied at 2–3 oz. per bushel of seed. At concentrations of 40 per cent. or over, the first three materials appreciably reduced attack and, when infestation was heavy, resulted in increased yield; between October and January, their effectiveness increased the later the wheat was sown [**48** 542, etc.]. There was evidence that they were less effective on highly organic soils. The other materials were either less effective or had other disadvantages. Seed dressings of γ BHC usually reduced the number of larvae entering the plant, but had little effect on larvae that succeeded in entering. Aldrin and dieldrin and probably most other materials usually had less effect on the entry of larvae, but were very effective in killing larvae after entry, so that the plant could subsequently recover. Combine-drilling of aldrin or dieldrin affected the larvae in the same way as seed dressings; in one season on a peaty soil, seed dressings were more effective than combine-drilling, but in another season on a mineral soil, combine-drilling was slightly the more effective. However, it was clear that in combine-drilling very much more insecticide per acre was needed to achieve a comparable result. The two materials were about equally effective.

Stoll (N. R.) & others. Ed. **International Code of Zoological Nomenclature adopted by the XV International Congress of Zoology.** [*In French & English.*]—$8\frac{3}{4} \times 5\frac{1}{2}$ in., xviii + 176 pp. London, Int. Comm. zool. Nom., 1961. Price £1.

The first internationally accepted rules of zoological nomenclature, the *Règles Internationales de la Nomenclature Zoologique*, were issued in 1905, in French, with English and German translations. Amendments and additions were made by subsequent International Congresses of Zoology, and those

made at the XIV Congress in 1953 were separately published as *Copenhagen Decisions on Zoological Nomenclature*. The present revision, which was adopted by the XV International Congress in London in 1958, is the only complete text officially to supersede the original *Règles*. The rules are drafted in English and French, preceded by a preface and an introduction in English and followed by five appendices, a glossary of terms and an index, all in English and French. The appendices, which are provided as a guide to good usage but do not have the force of rules, comprise a code of ethics to be observed in the publication of new names, a table showing the procedure to be followed in the latinisation of Greek words, directions as to the spellings to be adopted in the latinisation of the geographical and proper names of countries not using the Latin alphabet, recommendations on the formation of names and general recommendations.

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Benson (R. B.). **A new** *Gilpinia* [*G. pindrowi*, sp.n., on *Abies pindrow*] (**Hymenoptera Diprionidae**) **from Pakistan.**—*Ann. Mag. nat. Hist.* (13) **3** (1960) pp. 309–310, 3 figs., 2 refs. London, 1961.

Kimmins (D. E.). **Two new species of Hemerobiidae** [*Hemerobius montanus* and *H. adelgivorus*, spp.n., associated with *Chermes* (*Adelges*) on *Abies pindrow*] (**Order Neuroptera**) **from Pakistan.**—*Ann. Mag. nat. Hist.* (13) **3** (1960) pp. 337–342, 14 figs. London, 1961.

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Elliott (K. R.). **A history of recent infestations of the spruce budworm** [*Choristoneura fumiferana* (Clem.) on spruce and balsam fir (*Abies balsamea*)] **in northwestern Ontario, and an estimate of resultant timber losses.**—*For. Chron.* **36** no. 1 pp. 61–82, 2 figs., 13 maps on fldg. pl., 32 refs. Toronto, 1960.

Chemsak (J. A.). **A new species of** *Aneflomorpha* **Casey** [*A. citrana*, sp. n.] **associated with** *Citrus* **in Arizona** (**Coleoptera: Cerambycidae**).—*Pan-Pacif. Ent.* **36** no. 3 pp. 149–150, 1 ref. San Francisco, Cal., 1960.

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Boocock (D.). **A new technique** [using an emulsified oil solution of pentachlorophenol] **for eradication of timber pests.**—*Pest Technol.* **2** no. 10 pp. 196–202, 9 figs., 6 refs. London, 1960. [*Cf. R.A.E.*, A **47** 379.]

NOTICES

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